Stillaguamish River Watershed
Temperature
Total Maximum Daily Load

Water Quality Improvement Report
Vol. 2: Implementation Strategy

DRAFT

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Water Quality Improvement Report Vol. 2: Implementation Strategy

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Executive Summary

The Stillaguamish River basin in Snohomish and Skagit Counties, Washington, contains 870 miles of anadromous salmon habitat. The uses of the river by several species of salmon and other forms of cold-water aquatic life are at risk due to excessive warming during late summer, low-flow conditions.

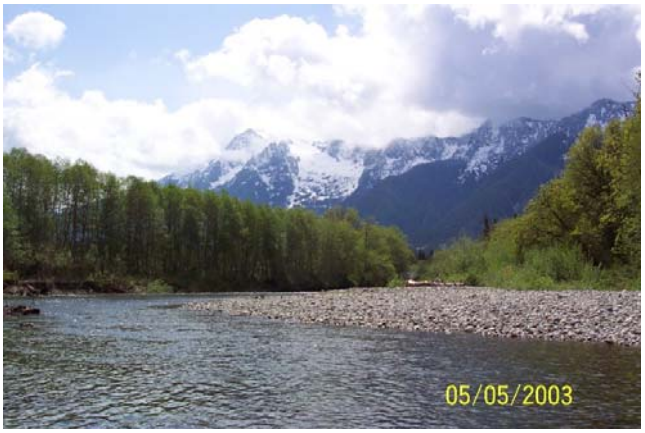


Figure 1 North Fork Stillaguamish River (Steve Hirschey, Ecology WR Program)

As required under the Clean Water Act, the Washington Department of Ecology (Ecology) conducted a Total Maximum Daily Load (TMDL) study (Ecology 2004) to address the impairments for temperature in the basin. If the study recommendations to reduce the amount of incoming solar radiation using full riparian vegetation are implemented, beneficial reductions in water temperature will result, eventually improving conditions for cold-water aquatic life.

The Stillaguamish Temperature TMDL study and its recommendations apply to 10 reaches of the river system. The 1998 303(d) list included seven stream reaches in the watershed impaired for temperature: Deer, Higgins, Little Deer, and Pilchuck creeks, and the mainstem, North Fork, and South Fork Stillaguamish River. In addition, the revised 303(d) list (also called the 2004 Water Quality Assessment) added Canyon, Jim and Glade Bekken creeks to the list. (Old Stillaguamish River, also identified as impaired for temperature, will be studied in a future report.)

The TMDL establishes the loading capacity of this river system for incoming solar radiation, and uses effective shade as a surrogate measure of heat flux. Effective shade is the fraction of incoming solar shortwave radiation that is blocked from reaching the stream surface. The loading capacity is defined as the combination of factors that affect the system potential temperature, which is an approximation of the summertime maximum temperatures that would occur under natural conditions. In areas where the system potential temperature is greater than the numeric criteria of 18 degrees C (Class A waters) or 16 degrees C (Class AA waters), then the natural conditions provision of the water quality standard is the basis of the loading capacity, load allocations, and wasteload allocations of this TMDL.

The natural conditions provision of the water quality standard ((WAC 173-201A-070(2)) states: "Whenever the natural conditions of said waters are of a lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria." The natural condition in this TMDL is approximated by stream temperatures that would occur with hypothetical conditions of four factors: riparian vegetation, microclimate, channel width, and groundwater inflows. The load allocation for each water body is the maximum potential effective shade that would occur with mature riparian vegetation.

In addition to load allocations for effective shade, the TMDL study recommends other management activities that could benefit stream temperature including measures to prevent channel widening; voluntary actions to protect or increase stream flow, such as voluntary retirement of water rights; and channel modifications that would maintain or increase hyporheic exchange and groundwater inflows. Also, this watershed has a number of natural and human-caused landslides that contribute a heavy load of sediment under both dry and wet conditions. Deposition of the sediment load in many locations has led to shallowing and widening of the river, resulting in greater solar exposure. Management activities that would reduce upland and channel erosion and avoid sedimentation of fine materials in the streambed are encouraged.

Point sources are also addressed. This report establishes wasteload allocations for two wastewater treatment facilities with National Pollutant Discharge Elimination System (NPDES) permits: the City of Arlington's facility on the mainstem Stillaguamish River and the Indian Ridge Corrections Facility on Jim Creek, a tributary to the South Fork. Both facilities will be allowed to continue discharging treated effluent to the river system, but, as allowed under state water quality standards, they may not cause an increase greater than 0.3^{o} C above the water quality criterion at the edge of the chronic mixing zone.

Ecology's implementation strategy is to encourage voluntary installation of riparian vegetation that will provide effective shade when mature. The lower watershed has mixed land uses including agricultural, rural residential, and urban-commercial areas in the rapidly-growing cities of Stanwood and Arlington. Local organizations including the Stillaguamish Tribe, City of Arlington, Snohomish County's Stillaguamish watershed steward, Stilly-Snohomish Fisheries Enhancement Task Force, and Snohomish Conservation District have active programs, some with landowner incentives, to plant and restore riparian areas in the lower watershed (Figure 2).

Both the City of Arlington and Snohomish County have critical area ordinances that require protection of streamside riparian habitat for parcels under development. In addition, Snohomish County's Shoreline Management Plan includes protections for the shorelines of estuarine and marine areas and the streambanks of rivers with average daily flow greater than 20 cfs.

Ecology makes Centennial Clean Water Fund (CCWF) grants available for competitive restoration and water quality-related projects and will award extra ranking points for projects that help implement approved TMDLs. For example, CCWF and state Salmon Recovery Funds have been awarded to a Stillaguamish Tribe project that will be designed to reduce sediment inputs from the Steelhead Haven landslide to the North Fork (Figure 3).

Figure 2. Volunteers planting native trees at Portage Creek Wildlife Sanctuary (Dave Steiner, Stilly-Snohomish Fisheries Enhancement Task Force)

Figure 3. Steelhead Haven landslide on North Fork prior to massive failure in January 2006 (Steve Hirschey, Ecology Water Resources Program)

In forested areas (82 percent of the watershed), forest practices regulations will implement the requirements. For National Forest lands, the TMDL recommends the riparian reserves in the Northwest Forest Plan. Washington State Department of Natural Resources land and private forest lands are subject to the revised forest practice regulations established under the Forests and Fish Agreement (DNR 1999). These include strict requirements for riparian protection.

Instream flows and water withdrawals are managed through regulatory avenues separate from TMDLs. However, stream temperature is related to flow; increases in flow generally result in decreases in maximum temperature. Thus, this report makes reference to the Stillaguamish Instream Flow Rule [Chapter 173-505 Washington Administrative Code (WAC)] because of its potential to protect against future additional water allocations that could lower river flow and exacerbate the existing temperature problems. Adopted in 2005, this rule established instream flows for 32 rivers and streams in the basin; reserved a limited amount of groundwater for future domestic use and stockwatering; established maximum limits for withdrawals from nine water sources; closed certain lakes and ponds to new diversions, except for domestic use; and closed numerous rivers and streams to new uses unless the use qualifies under identified exemptions.

After implementation is under way, adaptive management will be led by Ecology with participation of local agencies and interested organizations. These agencies and organizations will work with Ecology to review annually new water quality data and achievement of implementation milestones.

The target date for meeting the natural condition standard for temperature requires allowing for full maturation of newly planted riparian buffers. Implementing many planting programs will take five years or more, and native trees can mature in about 50 years, so the target date for reducing stream temperatures in the watershed is 2070. The Water Quality Implementation Plan (Volume 3 of the TMDL) that will follow this Water Quality Implementation Strategy will include measurable markers of compliance other than temperature reductions, such as miles of streambank planted and height of riparian vegetation, because it will take many years for changes in temperature to be measurable.

Introduction

The Washington Department of Ecology (Ecology) is concerned about protecting and restoring water quality in creeks and rivers of the Stillaguamish River watershed. This watershed, whose waters rise on the western slopes of the Cascade Mountains and drain westward to Port Susan, an inlet of Puget Sound, was famed in the early 1900s for its steelhead fishery. In the second half of the century, all runs of salmon and steelhead declined. The causes are several and complex, but among the factors identified by fisheries scientists as limiting salmon and steelhead populations in this watershed is high stream temperature during the late summer, low-flow season (Washington Conservation Commission, 1999).

This document, a Water Quality Improvement Report, Volume 2: Implementation Strategy, is the second report of three that are needed to address Stillaguamish River watershed streams and rivers impaired for temperature under the federal requirements for developing a Total Maximum Daily Load. The purpose of this volume is to describe how the streams and rivers of this watershed can begin to improve to meet water quality standards. It includes (1) a list of actions needed to improve water quality; (2) inclusion of the public in the decision making process; (3) a monitoring program to measure performance; and (4) the periodic readjustment of needed corrective actions if progress is not occurring rapidly enough (adaptive management).

State authority to set water quality standards and conduct TMDLs

Section 303(d) of the 1972 Clean Water Act (CWA) requires the U.S. Environmental Protection Agency, or a designated authority, to identify the polluted water bodies of the United States and to develop plans to clean them up. In Washington State, Ecology has this responsibility. Water bodies that do not meet federal or EPA-approved state water quality standards are initially put on the "303(d) list" of impaired waters. (In Washington State, these waters are listed as Category 5 of the Washington State Water Quality Assessment.) After being put on the 303(d) list, a plan must be prepared that will guide efforts to return local waters to good health. These plans are called Total Maximum Daily Loads (TMDLs).

Under a 1997 agreement with EPA, Ecology must follow a two-step process to complete a TMDL. First, Ecology prepares a TMDL submittal report for approval by EPA. The submittal report, also called a Water Quality Improvement Report, includes a technical study (Volume 1) that defines the amount of pollutant a water body can receive without exceeding water quality standards and assigns load allocations or amounts of pollutants as well as a margin of safety. The submittal report to EPA also includes an implementation strategy (Volume 2), which outlines the activities required to implement the TMDL. After EPA approves the submittal report, Ecology must prepare an implementation plan (Volume 3, the Water Quality Implementation Plan) describing the specific activities that individual parties must perform to achieve the TMDL load and wasteload allocations.

Washington's Water Quality Standards for temperature

Current standards

Numeric water quality criteria for freshwater Classes AA, A, and B state that temperature shall not exceed the following due to human activities:

	Temperature Standard not to Exceed
Class AA (extraordinary)	16.0° C
Class A (excellent)	18.0° C
Class B (good)	21.0° C

These numeric criteria are designed to ensure specific communities of aquatic life will be fully protected whenever and wherever the numeric criteria are met. The state standards recognize, however, that some waterbodies may not be able to meet the numeric criteria at all places and all times.

WAC 172-201A states that: *"Temperature shall not exceed [the numeric criteria] due to human activities. When natural conditions exceed [the numeric criteria], no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°." (WAC 173-201A-030(1)(c)(iv), (2)(c)(iv), (3)(c)(iv), (4)(c)(iii))*

Thus at times and locations where the assigned numeric criteria cannot be attained even under estimated natural conditions, the state standards hold human warming to a cumulative allowance for additional warming of 0.3°C above the natural conditions estimated for those locations and times.

In addition to placing a limit on the amount of human warming allowed when temperatures exceed the numeric criteria, the state standards restrict the amount of warming point and nonpoint sources can cause when temperatures are cooler than the numeric criteria. This is done to protect the natural temperature regime of a waterbody that fish and other aquatic life species have adapted to over time.

If natural conditions are below the temperature standard, the incremental temperature increase resulting from nonpoint source activities shall not exceed 2.8°C or bring the stream temperature above the specified standard of the class at any time (Chapter 173-201A-030 WAC). Where natural conditions are below the temperature standard, incremental temperature increases from point sources are restricted using the equation, $t_{increase} = 28/(T+7)$ for Class A waters, where T is the upstream water temperature.

Thus, if the upstream water temperature was 15°C, a facility would be permitted to increase the downstream temperature no more than 1.3°C. Under Washington's Water Quality Standards, mixing zones are allowed. The permitted temperature increase is applied at the edge of the chronic mixing zone, which is determined through a modeling analysis that evaluates the facility's rated discharge capacity in relation to flow of the receiving water at a specified low-

flow condition. The low flow condition used in mixing zone analyses is the 7Q10, or the 7-day average low flow that occurs at a frequency of once in 10 years.

Proposed standards

In 2003, Ecology adopted new water quality standards for temperature including numeric criteria based on seven-day average maxima and a system that assigns criteria to state waters based on their beneficial uses rather than on a classification system. In March 2006 EPA disapproved parts of these new water quality standards based on differences in the designation of certain reaches of some rivers and streams for spawning, juvenile rearing and migration of salmonid fishes. As a result, Ecology is currently proposing to adopt into rule EPA's use designations, which will result in more stringent temperature criteria in parts of some watersheds. Ecology will hold public hearings on the proposed rule in summer 2006.

For the Stillaguamish watershed, the proposed rule changes would result in:

Stream Reach	Current Criteria ^{o} C	Proposed Criteria ^{o}C (a)
Mainstem Stillaguamish	18	17.5
Jim Creek	18	16, 12
Pilchuck Creek	18	17.5, 16, 12
Deer Creek	18, 16	16, 12
North Fork	18, 16	16, 12
South Fork	18, 16	16, 12
Canyon Creek	18	16, 12

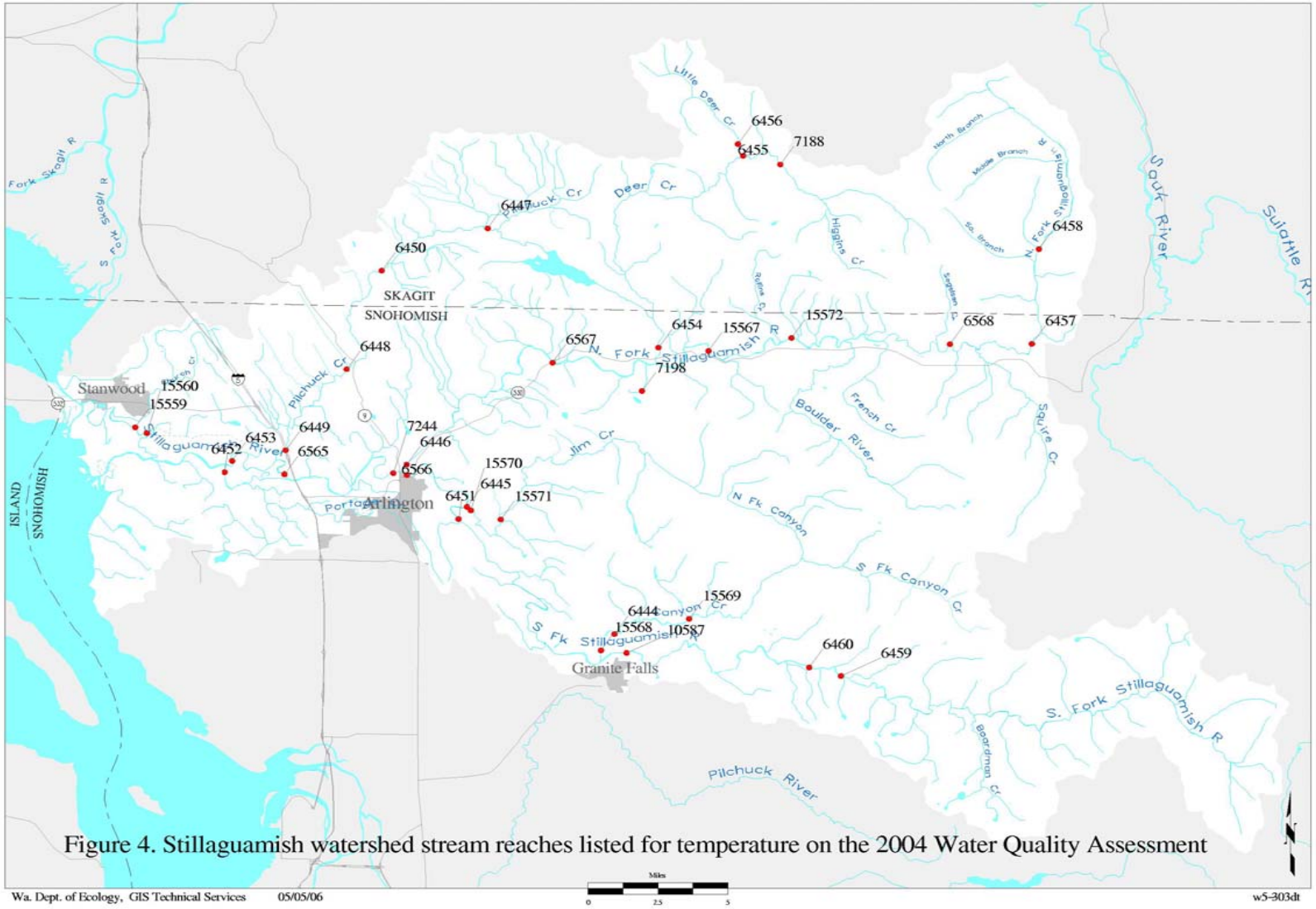
(a) These criteria are maximum 7-day averages of daily maximum temperatures

Temperature problems in the watershed

Ecology initiated the temperature TMDL study in 2000 to evaluate temperature conditions in the Stillaguamish watershed. Seven stream reaches were on the 303(d) list because of data documenting exceedances of the temperature standard: Deer, Higgins, Little Deer, and Pilchuck creeks, and the mainstem, North Fork, and South Fork Stillaguamish River. In 2005, EPA approved a revised and updated version of the 303(d) list, now called the 2004 Water Quality Assessment. In the revised list, Canyon, Jim and Glade Bekken creeks in the Stillaguamish were added to the list, for a total of 32 temperature impaired reaches (Table 1). (Two listings for temperature in the Old Stillaguamish Channel will be addressed separately in a future TMDL.) All the Stillaguamish reaches on the 2004 Water Quality Assessment are shown in Figure 4.

Table 1. Stillaguamish River watershed (WRIA 5) segments listed for temperature on the 2004 Water Quality Assessment and addressed in this report

Waterbody Name	Township	Range	Section	List ID
Deer Creek	32N	07E	08	6454
	33N	07E	01	7188
	34N	07E	35	6455
Higgins Creek	32N	07E	20	7198
Little Deer Creek	34N	07E	35	6456
	33N	05E	27	6450
	32N	05E	16	6448
	33N	06E	17	6447
Pilchuck Creek	32N	05E	31	6449
South Slough	31N	04E	02	6452
	31N	05E	06	6565
	31N	05E	02	7244
Stillaguamish River	31N	04E	02	6453
	32N	07E	10	15567
	32N	09E	7	6568
	32N	08E	6	15572
	31N	05E	2	6446
	32N	09E	10	6457
	32N	06E	15	6567
	32N	09E	22	7247
Stillaguamish River, N.F.	33N	09E	22	6458
	31N	05E	02	6566
	30N	08E	08	6460
	31N	06E	18	6451
	30N	08E	16	6459
Stillaguamish River, S.F.	30N	07E	07	10587
	30N	06E	12	15568
	30N	07E	06	6444
Canyon Creek	30N	07E	03	15569
	31N	06E	08	15570
	31N	06E	16	15571
Jim Creek	31N	06E	07	6445


Little Deer Cr
6456
6455
7188
Deer Cr
6447
Pilchuck Cr
6450
SKAGIT
SNOHOMISH
Higgins Cr
North Branch
Middle Branch
S. Branch
N. Fork Stillaguamish R
6458
Sauk River
Suiattle R
6454
15567
15572
6568
6457
6567
N. Fork Stillaguamish R
7198
6448
Pilchuck Cr
Stanwood
15560
15559
Stillaguamish River
6453
6452
6449
6565
7244
6446
6566
Jim Cr
Boulder River
French Cr
Squire Cr
15570
6445
6451
15571
Arlington
N Fk Canyon
S Fk Canyon Cr
ISLAND
SNOHOMISH
15569
6444
Canyon Cr
15568
10587
S Fk Stillaguamish R
6460
6459
Granite Falls
S. Fork Stillaguamish R
Boardman Cr
Pilchuck River
Figure 4. Stillaguamish watershed stream reaches listed for temperature on the 2004 Water Quality Assessment
Wa. Dept. of Ecology, GIS Technical Services 05/05/06
Miles
0
2.5
5
w5-303dt

Background: TMDL study (Volume 1)

Volume 1 is a report on the TMDL study conducted in 2001, which documented exceedances of water quality criteria for temperature in most parts of the watershed. Modeling was conducted to determine whether full riparian buffers with mature native trees and other improvements could reduce stream heating sufficiently to allow the water bodies to meet standards. The study established load allocations for shade and wasteload allocations for point source discharges to creeks and rivers in the watershed. Key results of that study are presented in *Volume 1, Stillaguamish River Watershed Total Maximum Daily Load Study* (available online at www.ecy.wa.gov/biblio/0403010.html).

To evaluate the influence of four factors: *riparian vegetation, microclimate, channel width, and groundwater inflows*, a water quality model was initially run with existing conditions of these factors, and the model's simulation of water temperature was compared with actual stream temperature data. Then the model was run with the hypothetical input conditions of maximum riparian shade, improved microclimate, reduced channel width, and increased groundwater inflows to determine whether this shade condition would enable the stream reach to meet the water quality criterion for temperature.

Ecology used Oregon Department of Environmental Quality's tTools extension for Arcview (ODEQ 2001) to sample and process GIS data for input to two models. Ecology's Shade model was used to estimate effective shade along the mainstem, North and South forks, Deer Creek and Pilchuck Creek; these estimates were then used as inputs to the QUAL2Kw model. The QUAL2Kw dynamic stream model was used to calculate the components of the heat budget and simulate water temperatures. It was calibrated to instream data collected in 2001 for the five reaches. A number of conservative assumptions made as part of the modeling process provide the required Margin of Safety for this TMDL.

The model results suggest that substantial reductions in water temperature (compared with the current regime) would occur with mature riparian vegetation, improvements in riparian microclimate, reduced channel width, and increases in groundwater inflows. Potential reduced temperatures are predicted to be less than the threshold for lethality of 23°C but greater than 18°C in Class A and greater than 16°C in Class AA waters in some or most of the segments in all streams that were evaluated.

The model predicts that the mainstem Stillaguamish, under critical low flow, late summer conditions, would not meet the Class A criterion, even with maximum riparian vegetation, microclimate improvement, reduced channel width, more groundwater recharge, and with all tributary waters at the water quality standard for temperature. However, substantial temperature reductions are predicted. Mature riparian vegetation, the most important factor, would reduce temperatures by about 3^{o} C, from about 26^{o} C to about 23^{o} C under critical conditions.

The model's results are similar for the South Fork, North Fork, Deer Creek and Pilchuck Creek. Under critical conditions, mature riparian vegetation is the most important factor for protecting stream temperature; however the combined effect of all factors is not sufficient for these water bodies to meet the temperature criterion.

Watershed description

The Stillaguamish River watershed covers 683 square miles and extends from sea level at Port Susan to an elevation of more than 6,000 feet on Whitehorse Mountain in the Squire Creek drainage. Based on Landsat imagery from the 1990s (USGS, 1999), the watershed is 82% forested and 6.5% in either developed or agricultural uses. The remaining 11.5% is comprised of barren, wetlands, herbaceous upland, shrubland, and non-natural woody areas.

Snohomish County used Landsat imagery from 2001 to assess riparian forest cover and determined that approximately 52% of the riparian area in the Stillaguamish watershed is forested with mature vegetation (Purser et al., 2003). The riparian forest cover reported for each of the sub-basins is listed in Table 2.

Table 2. Percent of riparian zone under forest cover in Stillaguamish sub-basins

Sub-basin	%	Sub-basin	%
Gold Basin	79	Pilchuck Creek (upper)	55
South Fork (upper)	79	French-Segelsen	50
North Fork (upper)	77	North Fork (middle)	48
Canyon Creek (upper)	77	Harvey Armstrong Creek	39
Stillaguamish Canyon	72	North Fork (lower)	38
Boulder River	70	Pilchuck Creek (lower)	36
Deer Creek	67	South Fork (lower)	34
Robe Valley	64	Port Susan drainages	34
Jim Creek	57	Church Creek	20
Canyon Creek (lower)	56	Portage Creek	19
Squire Creek	55	Stillaguamish River (lower)	16

Land ownership and forested areas

The recommendations in this Water Quality Improvement Plan focus on riparian protection and restoration. Requirements for riparian buffers vary with type of land ownership. Land ownership in the watershed is a mixture of public and privately owned land (Figure 5). A large part of the headwater areas of the North and South Fork Stillaguamish River is federally owned and managed according to the U.S. Forest Plan by the U.S. Forest Service as part of the Mount Baker Snoqualmie National Forest The lower portions of the watershed are primarily privately owned. The Washington State Department of Natural Resources (DNR) owns a significant portion of the middle region watershed. Both state and private forest lands are subject to the management practices prescribed in the Washington State DNR Forest and Fish Report (DNR, 1999).

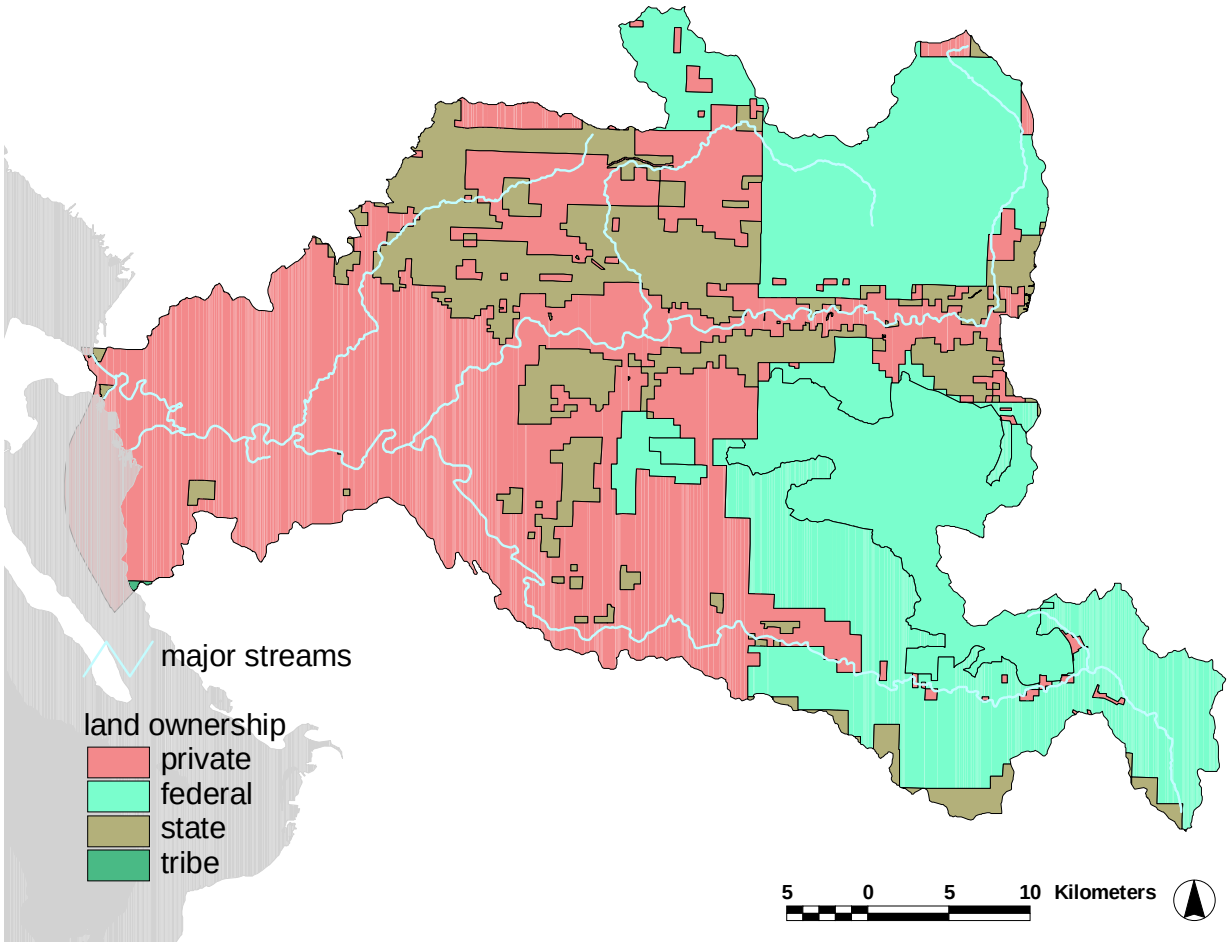


Figure 5. Land ownership in the Stillaguamish River watershed.

Lower watershed land uses

The Stillaguamish's urban centers are concentrated primarily in the lower third of the watershed, with Stanwood (population 4,190) at the river's mouth on Port Susan; Arlington (population 14,330) at river mile 17; Granite Falls (population 2,915) on the South Fork at river mile 27; and Darrington located on the divide between the North Fork drainage and the Sauk River, which drains north and is part of the Skagit River watershed.

The primary land use along the mainstem and lower reaches of the major forks is agricultural and rural residential, but also includes rapidly growing urban centers of Arlington and Stanwood. Most land is privately owned. In 1995 there were an estimated 909 commercial and non-commercial farms in the lower basin (Stienbarger, 1995). Although agriculture is still active, conversions to rural residential or non-commercial farm uses are becoming common along the Interstate 5 corridor. The state Department of Natural Resources controls approximately 28 square miles in the Pilchuck Creek sub-basin. Privately-owned forest lands are scattered throughout the upper reaches of other tributaries as well.

The Stillaguamish Tribe and Tulalip Tribes have important cultural and economic interests in the Stillaguamish River basin. The Stillaguamish Tribe offices are in Arlington and the Tulalip Tribes' offices are on the Tulalip Indian Reservation immediately south of the watershed. The Stillaguamish Tribe is a co-lead for salmon recovery programs in the watershed, and also contributes actively through its natural resources programs to understanding fisheries and water quality conditions.

The local watershed organization, the Stillaguamish Implementation Review Committee (SIRC), is the lead entity for salmon recovery in this watershed and has a high level of participation by municipalities, Tribes, non-profit organizations, and citizens. There is excellent support for, and interest in, both water quality and salmon recovery. Several member organizations have established programs for water quality and fish habitat restoration. This voluntary support for maintaining water quality is vital to maintaining the quality and function of the river system.

What Needs to be Done?

This section describes approaches to be used to reduce maximum summer temperatures of streams within the watershed. There are two different sources of heat loading to streams – point and nonpoint. Different approaches for reducing heat loading are required for the two types of heat loading to streams. Nonpoint heat sources include direct solar radiation and warming by ambient air and streambed. Thermal influences that are considered point sources include industrial and municipal wastewater discharges. In the Stillaguamish, two wastewater treatment plants discharge treated effluent to one of the watershed's rivers or streams.

Approaches for point sources

The permitted dischargers (point sources) associated with locations of impaired water quality in the TMDL study (Ecology 2004) are Wastewater Treatment Plants (WWTPs) with NPDES discharge permits. These facilities are assigned Wasteload Allocations (WLAs), which provide the basis for permit limits when the NPDES permit is reissued.

Discharge permits must be designed to meet the following elements of the state's temperature standards.

- A summer maximum criterion (e.g., the Class A 18^{o}C criterion)
- An incremental warming criterion. At times and locations when a threshold criterion would be exceeded under natural conditions, human sources both alone and combination may warm the water an additional 0.3°C above that condition.

In the Stillaguamish watershed, two WWTPs discharge effluent to reaches with temperature impairments: the City of Arlington's WWTP and the Indian Ridge Corrections Facility (currently closed; formerly managed by Snohomish County) on Jim Creek which drains to the South Fork.

Arlington WWTP is a 2 mgd facility that discharges to the mainstem Stillaguamish River just below the confluence of the North and South forks. This reach of the river has a temperature criterion of 18^{o}C (Class A) and is known to exceed the criterion during the warmest months of the year. Based on the modeling analysis in the TMDL study, it is unlikely, even with maximum riparian shaded condition, that this reach will be able to meet standards. In this situation the incremental warming criterion (above) applies; thus, the Wasteload Allocation (WLA) is defined as the heat load, or effluent temperature equivalent, that would result in no more than 0.3°C increase in temperature at the edge of a standard mixing zone:

$$T_{WLA} = (\text{Summer maximum criterion} - 0.3) + (\text{Dilution Factor})(0.3).$$

This calculation of T_{WLA} provides a basis for setting effluent limits in a discharge permit. Where meeting final effluent limits would require substantial cost, interim limits may be applied until a TMDL implementation plan is developed. This approach is reasonable where cost effective alternatives could be developed through pollution trading, regionalized treatment, or some other approach using this watershed-wide TMDL for implementation. If such opportunities are not reasonably foreseeable, final limits should be established with a compliance schedule set to attain compliance at the shortest practical time.

The City of Arlington's existing 2 mgd facility has a chronic dilution factor of 30 (Arlington, 1997), so the effluent temperature that would meet the incremental warming criterion can be calculated as:

$T_{WLA} = (18 – 0.3) + (cdf \times 0.3)$

$T_{WLA} = 26.7^{o}C$

For the two most recent summers, Arlington's maximum daily effluent discharge temperatures, measured in the late afternoon, were 24.0° C (August 14, 2004) and 23.8° C (August 12, 2005) (D. Randolph, City of Arlington, personal communication 2005). These temperatures are lower than the T_{WLA} for the current facility. However, if the plant were to increase its discharge capacity, a lower dilution factor would apply and the calculated T_{WLA} would also be reduced. In early 2006, the City of Arlington met with Ecology to discuss a potential expansion of the facility to 4 mgd. Ecology will review the City's engineering analyses for this proposed facility, including calculation of the chronic dilution factor, with respect to potential impacts on temperature of the Stillaguamish River at Arlington.

The Indian Ridge Corrections facility is currently closed, and the WWTP, which discharges to Jim Creek, is not operating. Should Snohomish County reopen Indian Ridge, Ecology will request that the operators maintain daily effluent temperature records to ascertain compliance with temperature requirements of this TMDL (M. Dawda, personal communication, 2006). Like the Arlington WWTP, Indian Ridge will be prohibited from discharging treated effluent at a temperature greater than that equivalent to the water quality criterion for the reach plus 0.3° C times the chronic dilution factor for the facility.

Approaches for nonpoint sources

The TMDL study (Ecology 2004) identified several approaches for reducing overall heat inputs to the river system: Installation and maturation of full riparian vegetation; projects with potential to increase groundwater inflows to streams; voluntary retirement of water rights; and management activities that could reduce sediment inputs and narrow channel widths. Also, because groundwater and hyporheic exchange flow are important for maintaining cooler stream temperature, the study also recommended avoidance or prevention of actions that could reduce hyporheic exchange flow or inflow of groundwater. Protection of the existing flow regime is provided by the Stillaguamish River Instream Flow Rule [Chapter 173-505 Washington Administrative Code (WAC)].

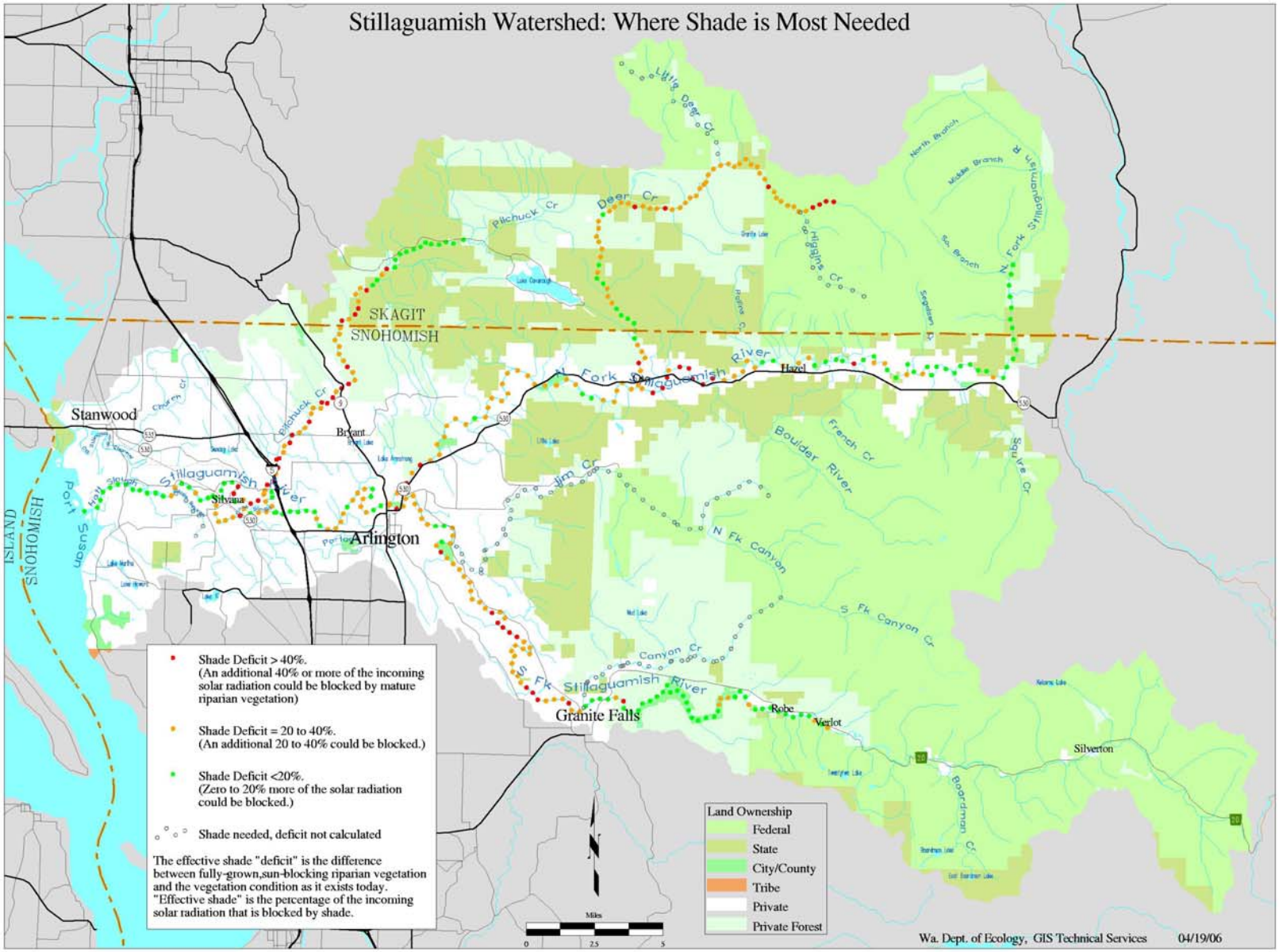
Additional mature riparian vegetation

For nonpoint sources of heat, the primary tool for addressing stream temperature impairments in the Stillaguamish watershed is protecting the existing riparian vegetation and increasing the overall quantity of mature native riparian vegetation that can shade the river and its tributaries. In addition to its direct role in blocking incoming solar radiation, riparian vegetation creates an area of moderating microclimate, stabilizes streambanks, and can filter out unwanted substances before they are carried by surface runoff into streams.

The map of the watershed (Figure 6) identifies the highest-priority areas of river and stream reaches in the watershed that should be addressed through riparian planting and restoration projects. The priorities assigned in this figure are based on the findings of the TMDL temperature study and reflect both the effectiveness of the shade that could be achieved (i.e., shade is generally more effective in cooling smaller streams than it is in cooling larger streams) and the current vegetation status of the streams that are prioritized (i.e., currently unvegetated riparian areas are given higher priority than those with existing, albeit not mature, vegetation).

This TMDL focuses on the programs and activities needed for riparian restoration and protection in those areas that are not private commercial forest, U.S. National Forest, or state Department of Natural Resources (DNR) lands, because these areas have their own prescriptions for buffer protection of streams.

For U.S. Forest Service land, the Northwest Forest Plan (USDA and USDI, 1994) requires riparian reserves that allow for the establishment of mature riparian vegetation. Other forest land in the watershed is subject to practices outlined in the Washington State DNR Forest and Fish Report (DNR 1997). Consistent with the Forests and Fish agreement, implementation of the load allocations established in this TMDL for private and state forestlands will be accomplished via implementation of the revised forest practice regulations.


Stillaguamish Watershed: Where Shade is Most Needed
SKAGIT
SNOHOMISH
ISLAND
SNOHOMISH
Stanwood
Bryant
Arlington
Silvana
Hazel
Granite Falls
Robe
Verlot
Silverton
Deer Cr
Pilchuck Cr
Boulder River
French Cr
Jim Cr
N Fk Canyon
S Fk Canyon Cr
Canyon Cr
Boardman Cr
N Fork Stillaguamish River
S Fk Stillaguamish River
Stillaguamish River
Port Susan
Shade Deficit > 40%.
(An additional 40% or more of the incoming solar radiation could be blocked by mature riparian vegetation)
Shade Deficit = 20 to 40%.
(An additional 20 to 40% could be blocked.)
Shade Deficit <20%.
(Zero to 20% more of the solar radiation could be blocked.)
Shade needed, deficit not calculated
The effective shade "deficit" is the difference between fully-grown,sun-blocking riparian vegetation and the vegetation condition as it exists today. "Effective shade" is the percentage of the incoming solar radiation that is blocked by shade.
Land Ownership
Federal
State
City/County
Tribe
Private
Private Forest
Miles
0
2.5
5
Wa. Dept. of Ecology, GIS Technical Services 04/19/06

The effectiveness of the Forests and Fish rules will be measured through the adaptive management process and monitoring of streams in the watershed. If shade is not moving on a path toward the TMDL load allocation by 2009, Ecology will suggest changes to the Forest Practices Board.

The remaining areas of the watershed are those primarily addressed by this TMDL: the riparian borders of agricultural lands; rural and suburban areas; and urban centers, most of which are privately owned. Local and Tribal governments and non-governmental organizations can encourage riparian protection and habitat enhancement through education of citizens; city and county governments can adopt and enforce riparian and shoreline protections and buffers prescribed under critical areas ordinances and shoreline management plans. These land uses (indicated in white in Figure 6) are concentrated along the mainstem Stillaguamish and its tributaries in the lower watershed but also include the riparian area for many miles along the North Fork (all the way to Darrington), and all of the South Fork as far as Granite Falls.

Stillaguamish River instream flow rule

Ecology is required by law to protect instream flows by adopting regulations and to manage water uses that affect streamflow. To develop an "instream flow rule," which sets for a particular stream the minimum flows needed, Ecology considers existing flow data, stream hydrology and natural seasonal variation in flow, water quality, fish habitat needs, and other factors. An adopted instream flow rule acquires a priority date and water right seniority the same as that associated with a water right. Water rights existing at the time an instream flow rule is adopted are unaffected by the instream flow and those issued after rule adoption are subject to the requirements of the rule.

Instream flows and water withdrawals are managed through regulatory avenues separate from TMDLs. However, stream temperature is related to the amount of instream flow. In a stream, the more flow there is, the less sensitive the water temperature is to the influences of streambed and groundwater temperature, air temperature, and solar radiation. The smaller the flow, the more these external influences determine stream temperature. Because of this relationship, considering stream temperature issues when setting a minimum flow needed during critical times of year is a way to help protect the stream's temperature regime. Having an instream flow rule for a particular stream doesn't mean that it will never exceed the water quality standard for temperature, but it provides some protection against future water rights removing water and changing the stream's natural flow and ability to regulate temperature.

On August 29, 2005, Ecology adopted the Instream Flow Rule for the Stillaguamish River, Chapter 173-505 Washington Administrative Code (WAC). This rule, which became effective on September 26, 2005, established instream flows for 32 rivers and streams in the basin, reserved a limited amount of groundwater for future domestic use, reserved a limited amount of water for stockwatering; established maximum limits for withdrawals from nine water sources; closed certain lakes and ponds to new diversions, except for domestic use; and closed numerous rivers and streams to new uses unless the use qualifies under identified exemptions.

The administrative closures to new water rights were established for Armstrong, Deer, Fortson, Segelsen, Jim, Moore, Squire, Grant, and French creeks from June to November. In addition, the

rule reaffirms prior closures for Canyon, Pilchuck, Portage, and Church creeks. The rule does not affect existing water rights, including those who have small wells already in place that are exempt from state permitting requirements and people who receive their supplies from municipal or community water systems. General information about the state's process for establishing instream flows can be found on the web at www.ecy.wa.gov/programs/wr/instream-flows/isfhm.html**.**

Who Needs to Participate?

Tribes, local agencies and Stillaguamish watershed organizations have ongoing programs that will assist in making improvements to water quality in the Stillaguamish basin. This section describes the capabilities of each organization to complete on-the-ground water quality projects that will lead to reduced stream temperatures. Each organization has a unique approach to restoration based on its funding sources and its responsibilities for reaching its own goals. And, although there are some opportunities for restoration on public lands, such as at Snohomish County's Portage Creek Wildlife Sanctuary, a great deal of work needs to be done on private property. As a result, organizations with capabilities for conveying a message about the importance of riparian restoration are vital to this effort to recruit more "willing landowners." This section also describes the role of Ecology and EPA in overseeing TMDL development.

Stillaguamish Implementation Review Committee (SIRC)

The Stillaguamish Implementation Review Committee (SIRC) is a watershed-based local stakeholder group established in the early 1990s. The SIRC's mission is to restore and maintain a healthy, functioning Stillaguamish River watershed by providing a local forum in which agencies, organizations, communities and the public can engage in a collaborative watershed-based process of decision-making and coordination. Its initial focus was to oversee implementation of the 1990 Stillaguamish Watershed Action Plan, which included 71 recommendations for controlling non-point pollution in the watershed.

In the mid-1990s, the SIRC added salmon habitat restoration issues to its scope. Since 1999, with leadership from the Stillaguamish Tribe and Snohomish County, the SIRC has served as the local citizens' committee for recommending prioritized lists of salmon habitat restoration projects to the Washington State Salmon Recovery Funding Board. SIRC has final oversight authority for lead entity projects, including salmon habitat project lists and the habitat restoration work schedule.

Currently, the following are member organizations of SIRC:

- City of Arlington
- City of Stanwood
- Clean Water District Advisory Board
- Federation of Fly Fishers
- Mainstem Stillaguamish community
- The Nature Conservancy
- North Fork Stillaguamish community
- South Fork Stillaguamish community
- Pilchuck Audubon Society
- Snohomish Conservation District
- Snohomish County Council
- Snohomish County Surface Water Management

- Stillaguamish Flood Control District
- Stillaguamish Grange
- Stillaguamish Tribe
- Stillaguamish-Snohomish Fisheries Enhancement Task Force
- Twin City Foods
- Tulalip Tribes
- U.S. Forest Service
- Washington Dairy Federation
- Washington Dept of Ecology
- Washington Dept of Fish & Wildlife
- Washington Dept of Natural Resources
- Washington Farm Forestry Association
- WSU Cooperative Extension

In May 2005, SIRC issued the Stillaguamish (WRIA 5) Chinook Salmon Recovery Plan (SIRC, 2005) which recommends an integrated strategy for protecting and restoring Chinook salmon populations. The strategy includes recommendations for habitat restoration projects; compliance and enforcement of existing regulations; policy and regulatory coordination; preliminary commitments and conditions to achieve recovery objectives; monitoring and adaptive management; and public outreach and coordination.

The Chinook Salmon Recovery Plan and Ecology's Stillaguamish Temperature TMDL share a common goal of reducing stream temperatures in many parts of the watershed, because of the critical role cold water temperature plays in the lives of salmonid fishes. Temperature is considered one of several habitat limiting factors contributing to the Chinook salmon population decline. As a result, riparian restoration projects that include planting to block solar radiation, erosion control projects to reduce the river's sediment load, and projects that restore connections with temperature-moderating groundwater, will serve the objectives of both programs.

Clean Water District

The Stillaguamish Clean Water District was established in 1993 by Snohomish County Ordinance 96-080, Title 25 A, to improve drainage, water quality and fish habitat/shellfish beds. This establishment occurred after the state Department of Health indicated, in response to a request, that water quality would not be good enough to open shellfish beds in Port Susan to commercial harvest. Parcels in the district are assessed an annual fee to support the goals of the Clean Water District. Originally called the Lower Stillaguamish Clean Water District, its geographic coverage and fee assessment area were expanded to comprise the full Stillaguamish watershed by action of County Council in January 2005. Currently, 33% of fees are allocated to the Snohomish Conservation District to reduce pollution; 59.1% is allocated to water quality restoration activities administered by Public Works, including funding of the Stillaguamish Steward position; and the remaining 7.9% is allocated to Department of Public Works for local water quality restoration projects that are recommended by the Clean Water District Advisory Board.

Each year, several of the projects undertaken by the Stillaguamish Steward and the Conservation District with funding provided by the Clean Water District are riparian restoration projects on private land and include installation of native vegetation that will provide riparian shade when mature. In addition, the Board of the Clean Water District writes an annual letter of work priorities and recommended actions to the director of Snohomish County Surface Water Management. The annual letter to the director is another opportunity for this temperature TMDL's recommendations for riparian planting and restoration throughout the watershed to be made more visible to County Surface Water Management.

City of Arlington

The City of Arlington borders the South Fork Stillaguamish River and a short extent of the mainstem, totalling about one mile of shoreline. Just below the confluence of the two forks, the city operates a 2-mgd wastewater treatment facility (WWTP) that discharges treated effluent to the river and a drinking water treatment facility serving more than 4,000 connections. Through city efforts, riparian plantings have been installed at 26 sites along a total of about five miles of streambank within the city limits (see completed projects summary, Appendix B).

City of Arlington has a Critical Areas Ordinance for properties on streams that prescribes a buffer width ranging from 25 to 150 feet depending on land type, land use and whether land use conversion is involved.

Snohomish County Surface Water Management

Snohomish County Surface Water Management (SWM) administers a water quality monitoring program in the Stillaguamish basin and also manages a number of programs that improve water quality. The County has monitored eight sites monthly in this watershed since 1994, and targeted monitoring has been conducted to assess the effect of small farm BMPs and riparian restoration projects. SWM programs that directly benefit water quality in the Stillaguamish watershed include:

- A strong public outreach program, which consists of educational programs for students, teachers, and the general public. The County also has a native plant salvage program that generates hundreds of hours of volunteer time each year in watershed restoration projects. A full-time watershed steward is assigned to work with citizens on riparian restoration, small farm BMPs, and other water quality projects throughout the Watershed (see recent projects in Appendix B).
- A Water Pollution Control Ordinance (Chapter 7.53 Snohomish County Code) in March 1998. The ordinance prohibits the discharge of pollutants to County Streams.
- Water quality monitoring data are available on the internet at http://www.data.surfacewater.info. The County provides support to the Washington State Department of Health in monitoring South Skagit Bay for bacteria.
- As part of Phase I NPDES Municipal Stormwater Permit requirements, the County identifies and inspects selected storm sewer outfalls in the Stillaguamish watershed, inspects residential stormwater detention facilities, has an illicit discharge detection and

elimination program, maintains its storm sewer system, and identifies and implements drainage infrastructure improvements.

Under requirements of the Growth Management Act, Snohomish County is updating its Critical Areas Ordinances. The ordinances will include protections for riparian buffers and wildlife habitat along streams and areas of groundwater recharge, such as wetlands, that can influence stream flow and temperature.

Stillaguamish Tribe

The Stillaguamish Tribe Natural Resources Department administers a number of programs that contribute to understanding of, and making improvements to, the watershed conditions that affect salmonid and other fish and shellfish resources of the Stillaguamish watershed and Port Susan. Programs include:

- Leadership and support for the Stillaguamish Implementation Review Committee and its goals of increasing salmonid populations and improving water quality throughout the basin. Writing grant proposals for, and managing, projects involving salmon habitat assessment and riparian restoration.
- Water quality monitoring of Port Susan under a cooperative agreement with the Department of Health to assess conditions for commercial and recreational shellfish harvest.
- Water quality monitoring at a number of locations throughout the watershed, including a study of the effects of a flow enhancing structure on the upstream end of the Old Stilly Channel.
- Certification to negotiate CREP (Conservation Reserve Enhancement Program) contracts with landowners to plant riparian buffers and fence livestock away from streams to prevent or reduce fecal coliform pollution.
- Banksavers Program, a for-profit native plant nursery that maintains native plant nursery stock and manages riparian planting and maintenance projects (Appendix B).
- Operating a smolt trap on the Stillaguamish River to help determine numbers of coho and chinook smolts.
- Operating a hatchery on Harvey Creek

Snohomish Conservation District

The Snohomish Conservation District (SCD) works throughout Snohomish County and on Camano Island with landowners and livestock owners in developing resource management plans. A principle focus of their work is surface water quality protection. The SCD provides information and services related to riparian and instream restoration, soils, and nutrient management. In addition they may be assisted in providing technical assistance on soil science, hydrology, forestry, wetlands and engineering by the Natural Resource Conservation Service (NRCS).

The SCD provides technical assistance, farm plans and cost-share funds for the implementation of BMPs using state and federal funding sources. TMDL-related BMPs that are recommended and implemented include: fencing livestock out of streams, improving pasture and nutrient management, installing gutters to keep water away from barnyard areas, composting and storage of manure, and planting riparian buffers. These BMPs help prevent the transport of mud, nutrients and manure to surface waters and improve watershed health overall. The SCD implements riparian restoration through the Conservation Reserve and Enhancement Program (CREP) and conducts water quality monitoring (recent projects – Appendix B).

The SCD has a strong program of education and outreach; each year they organize a number of workshops and evening programs on Small Farms Management, Horses for Clean Water, and other topics. These workshops are well attended by 30 to 100 people.

Additional services the SCD is interested in providing, should resources be available, would assist in achieving the goals of this TMDL. These include:

- Sub-basin water quality monitoring coordinated with education and outreach to landowners in the sub-basin
- Focused BMP effectiveness monitoring
- Inventory of farms, including "animal census" information
- New and expanded financial assistance programs for farm planning and BMP implementation

Stilly-Snohomish Fisheries Enhancement Task Force

The Stilly-Snohomish Fisheries Enhancement Task Force is a 501(c) (3) nonprofit corporation based in Everett. The mission of the Task Force is to ensure the future of salmon in the Stillaguamish and Snohomish watersheds. Since 1990 the Task Force has developed community partnerships and strategies for restoring salmon habitat. It has conducted a number of volunteer planting events and stream restoration projects in the Stillaguamish watershed, including tree planting projects on Portage Creek and Glade Bekken Creek near Silvana and programs to educate landowners about, and control, invasive knotweed. The Task Force has an active program of working in high school and elementary classrooms, providing hands-on opportunities for youth to learn about salmon and water quality and the importance of good stewardship of both land and water. These outreach events are extremely valuable toward the overall goal of educating watershed residents about the importance of good habitat for salmon, and the value of mature native riparian vegetation in improving water quality and salmon habitat.

Tulalip Tribes

The Tulalip Tribes are a sovereign nation with land use authority within their reservation in Marysville. Usual and Accustomed fishing areas include Port Susan and the Stillaguamish River. The Tribes' Water Quality and Fisheries Department has conducted water quality monitoring programs in the watershed and has an interest in targeting priority areas of the watershed and assessing success of implementation activities. The Tribes have supported a

number of water quality, aquatic habitat and fisheries-related studies of the Stillaguamish River watershed.

Ecology

Washington State Department of Ecology has been delegated authority under the federal Clean Water Act by the U.S. EPA to establish water quality standards and enforce water quality regulations under Water Pollution Control Act, Chapter 90.48 RCW. Ecology provides staff from the Environmental Assessment and Water Quality programs who conduct monitoring, analyses, and coordination with local organizations in developing Total Maximum Daily Loads for impaired waters. Ecology has enforcement authority for NPDES permits and for nonpoint pollution for pasture-based livestock operations. In addition to this regulatory role, Ecology provides financial assistance to local governments, Tribes, and conservation districts for water quality projects. Projects that implement Water Cleanup Plans (TMDLs) are a high priority for funding.

U.S. Environmental Protection Agency

The EPA is responsible for reviewing and approving Ecology's TMDLs and enforcement of the Clean Water Act. EPA provides funding for states and tribes to implement the Clean Water Act.

Washington State Department of Agriculture

Washington State Department of Agriculture has responsibility for the state Nutrient Management Program which includes an inspection and enforcement program for the dairy industry and for Concentrated Animal Feeding Operations.

What is the Schedule for Achieving Water Quality Standards?

The following table is a program of milestones and target dates for developing and implementing the recommendations of this TMDL. This table will be further developed in Volume 3: Water Quality Implementation Plan.

Table 3. Schedule for TMDL milestones and achieving water quality goals

Task	*Responsible Organization*	*Target Date*
Pre-DIP review of water quality data/Prioritize actions	*Ecology with local organizations*	*December 2006 (complete)*
Preliminary list of riparian improvement projects and activities	*Ecology with local organizations*	*March 2007*
Implementation/Restoration and planting	*Local organizations*	*Ongoing*
First annual review of water quality data/Review & discuss actions	*Ecology with local organizations*	*April 2007*
Water Quality Implementation Plan	*Ecology with local organizations*	*September 2007*
Second, 3rd, 4th and 5th annual reviews of water quality data/Review & discuss actions	*Ecology with local organizations*	*April 2008, 2009, 2010, 2011*
Effectiveness monitoring	*Ecology*	*To be determined*
Measurable reductions in temperature	*Ecology*	*2040 or later?*
Achieve system potential temperature	*Ecology with local organizations*	*2070*

Because it will take many years for a number of planting projects to be completed, the date for effectiveness monitoring will be determined at an appropriate time in the future.

Reasonable Assurances

Ecology believes that the activities and programs in the Stillaguamish watershed (examples; Appendix B) are already supporting this TMDL and add to the assurance that stream temperatures in the Stillaguamish River watershed will be reduced over time as riparian protection, restoration and planting continue to be implemented.

The following information provides reasonable assurance that the Stillaguamish Watershed water quality goals will be met by 2070. Considerable interest and local commitment to improve and protect water quality and restore salmon habitat in the watershed are evident in these examples:

- The Stillaguamish Tribe has two grants (one an Ecology Centennial Fund grant) earmarked for addressing excessive sediment inputs to the North Fork from the Steelhead Haven landslide. The slide experienced a new massive failure in January 2006, pushing material 700 feet south, blocking the river and threatening homes. Emergency work by Snohomish County and the Corps of Engineers made a new channel to save the homes. The Tribe will use the funding for design and construction to provide stabilization, add wood to the river, and reduce sediment input from this large slide, which increases the river's shallowing and widening, and exposes it to greater solar heating.

- The Stillaguamish Tribe was awarded grants from the state Salmon Recovery Fund and the National Fish and Wildlife Foundation to support its Bank Savers Project through 2009. This program is one of the principal vehicles for on-the-ground riparian planting and restoration in the watershed (see Appendix B, completed projects).

- Snohomish County is updating the County Shoreline Management Plan for adoption by end of 2006. Planning staff have received a copy of the "Shade Most Needed" map and GIS data documenting the high priority riparian shade locations summarized in Figure 6. The County has also included these priority shade locations as a data layer in the Shoreline Management Plan (K. Stewart, personal communication, 2005) for reference as the County reviews development proposals in the future.
- The SIRC has identified water quality as one of its highest priorities as it seeks to protect and restore salmonid habitat throughout the watershed. Local government agencies and individual citizens are well represented and involved at SIRC meetings and at Clean Water District meetings.
- The Stilly-Snohomish Fisheries Enhancement Task Force is successful in attracting a substantial number of volunteers to planting and other restoration activities and in providing educational programs for schools.
- Snohomish County's Stillaguamish Steward is experienced and successful in outreach to private landowners and increasing participation in riparian restoration projects.
- Snohomish Conservation District (SCD) will continue to provide technical assistance and best management practices implementation for Stillaguamish watershed small farms and agricultural activities. In July 2005 the SCD was awarded Centennial Grant funds to provide

small farm BMP education, including riparian vegetation improvements, in the Harvey-Kackman-Armstrong and March and Fish Creek subwatersheds. Included in the project are funds for water quality monitoring, which will provide an additional informal means of education and outreach to local residents during sampling events.

Whenever applicable BMPs are not being implemented and Ecology has reason to believe that individual sites or facilities are causing pollution in violation of RCW 90.48.080, Ecology may pursue orders, directives, permits, or enforcement actions to gain compliance with the state's water quality standards. Ecology will enforce water quality regulations under Chapter 90.48 RCW in pursuit of the objectives of this TMDL. While Ecology is authorized under Chapter 90.48 RCW to impose strict requirements or issue enforcement actions to achieve compliance with state water quality standards, it is the goal of all participants in the Stillaguamish watershed TMDL process to achieve clean water through voluntary pollution control actions.

Adaptive Management

Implementation of the Stillaguamish River Watershed TMDL will be adaptively managed such that the listed reaches of the river system will meet the system potential temperature by 2070. Adaptive management could include adjusting best management practices, helping develop and fund water quality projects that address the required temperature reductions, local education initiatives, and other means of conforming management measures to current information on the impairment. If water quality standards are met without attaining the load reductions specified in this document, then the objectives of this TMDL are met and no further reductions are needed. Adaptive management will follow this process:

(1) The Water Quality Implementation Plan will be developed by Ecology with review and participation of local agencies and organizations. It will prioritize locations for addressing water quality problems, assign local responsibility, list activities needed to address the problem, and develop a schedule for the activities.

(2) The Water Quality Implementation Plan will also identify locations within the Stillaguamish watershed where additional monitoring is needed.

(3) Ecology will facilitate an annual review of water quality data and implementation activites with participation by local organizations and agencies, including Snohomish County Surface Water Management, the Stillaguamish and Tulalip Tribes, the City of Arlington, Snohomish Conservation District and other partner organizations. A summary spreadsheet will be developed to assist in implementation tracking. It is expected that some activities, such as education and outreach programs, will be County-wide or watershed-wide.

(4) Adjustments will be made to the Water Quality Implementation Plan, based on annual review of water quality data and activities, to ensure that sampling locations and activity priorities continue to be effective. The updated Water Quality Implementation Plan will be made available to local organizations so that programs and grant applications can be adjusted to reflect changes in priority locations and actions and identified education and outreach needs.

(5) Riparian planting priority locations and milestones for accomplishing planting will be developed in the Water Quality Implementation Plan. It will take years to develop evidence that additional shade is contributing to a cooler temperature regime, and thus assessment in the initial years will focus on appropriate measures such as miles of stream planted, percent survival of plants after five years, or average stand height.

(6) Effectiveness monitoring of water quality (stream temperature) by Ecology will be scheduled for an appropriate future year when temperature reductions are expected to be measurable. The long term monitoring stations maintained by Ecology (see Monitoring Strategy section below) may prove to be sufficient to document changes and adaptively manage implementation. The decision to schedule effectiveness monitoring will depend on best professional judgment that measurable improvement in water quality has occurred, based on the annual review of water quality and implementation activities.

Summary of Public Involvement Methods

In 2000 through 2006, Ecology held a number of meetings for local stakeholder organizations and citizen representatives to involve them in developing the Stillaguamish Temperature TMDL. A news release in August 2004 about publication of the TMDL study resulted in a visit to the watershed to view restoration projects by Seattle Times reporter Christopher Schwarzen, whose article, "Bacteria, other pollutants in Stillaguamish targeted," was published September 9th.

The draft TMDL Implementation Strategy was circulated for local organization review in November 2004 and a revised draft circulated in May and June 2006. A public meeting was held on November 9, 2004, at Pioneer Museum in Arlington, to present the Implementation Strategy for the Temperature TMDL. Public notice for the commencement of the public comment period and public meeting consisted of a mailed Focus Sheet and legal advertisement in the Arlington and Everett newspapers on November 3, 2004.

In addition to TMDL-specific public meetings, Ecology's TMDL regional lead participates in regular meetings of the SIRC, the Stillaguamish Clean Water District Advisory Board, and the Stillaguamish lead entity Technical Advisory Group. Ecology participation in Stillaguamish Tribe's Festival of the River (annually in August) and Snohomish County Park Department's Discovery Day at Portage Creek (annually in July) have provided opportunities to acquaint the public with Ecology TMDL goals for this watershed and the need for riparian restoration to reduce stream temperature and improve salmon habitat.

Ecology's Response to public comments on draft Volume 2 is provided in Appendix A.

Potential Funding Sources

The Centennial Clean Water Fund, Section 319 grants under the federal Clean Water Act, and State Revolving Fund loans are available to fund activities by jurisdictions to help implementation of the TMDL. For example, both CCWF and funds from the Salmon Recovery Funding Board in 2004 were awarded to the Stillaguamish Tribe for the Steelhead Haven Landslide Project which will reduce sediment loading and protect the river from the shallowing and widening (causing increased exposure to solar radiation) effects of this landslide. Non-governmental organizations can apply for 319 grant funding. Should additional funding be necessary to reach standards, Ecology will work with the local organizations to prepare appropriate scopes of work, to implement this TMDL, and to assist with applying for grant opportunities as they arise.

The Puget Sound Water Quality Action Team administers Public Involvement and Education grants. The Conservation District provides technical assistance and BMP cost-share funding using local (Clean Water District), state and federal funds, as available. The Stillaguamish Tribe and the Conservation District write CREP plans and work with landowners to get riparian buffers installed with funds from the Farm Service Agency and the Washington Conservation Commission. The federal Natural Resources Conservation Service provides some technical assistance and also administers the Environmental Quality Incentive Program (EQIP), which provides cost share funds for BMPs on agricultural sites. Stream restoration activities are eligible for salmon restoration grants through various sources, including the Salmon Recovery Funding Board.

The Stillaguamish Clean Water District is supported through a fee assessment on watershed property owners for projects related to drainage and improved water quality in Port Susan. Besides the portion administered by Snohomish County Surface Water Management for drainage and other improvement projects, some Clean Water District fees go to Snohomish Conservation District (above paragraph); also a Discretionary Fund of approximately $45,000 is available annually for on-the-ground projects to improve water quality and aquatic habitat. The Clean Water District Citizens Advisory Board is charged with reviewing grant applications for these funds.

Monitoring Plan

EPA (1991) guidance calls for a monitoring program for evaluating progress on TMDLs. Monitoring is important for assessing the progress or success of implementation measures based on the total maximum daily load (TMDL) recommendations. Post-implementation monitoring is required in the TMDL process to ensure that water quality standards are being attained and that implementation measures are effective. If water quality standards are not met after the TMDL has been established, then adjustments to the load and wasteload allocations may be required, or implementation activities may require modification.

Successful TMDL evaluations require several types of monitoring data. Water quality, aquatic resources, land use, and implementation activity data are needed to evaluate the progress and effectiveness of the TMDL. The details of the location, type, and timing of data collection and TMDL compliance schedule will be provided in the Water Quality Implementation Plan (Volume 3).

Recommendations for Monitoring

To determine the effects of management strategies within the Stillaguamish River watershed, regular monitoring is recommended. Continuously-recording water temperature monitors should be deployed from July through September to capture the critical conditions. The following locations are suggested for a minimal sampling program:

- Stillaguamish River at Norman Road
- South Fork Stillaguamish River near mouth
- North Fork Stillaguamish River near mouth
- Deer Creek near mouth
- Pilchuck Creek near mouth

Shade management practices involve the development of mature riparian vegetation, which requires many years to become established. Interim monitoring of water temperatures during summer is recommended, and could be as infrequent as five-year intervals because of the long time needed to establish riparian vegetation. Interim monitoring of the composition and extent of riparian vegetation is also recommended (for example, by using photogrammetry or remote sensing methods).

Methods to measure effective shade at the stream center in various segments for comparison with the load allocations could employ hemispherical photography, angular canopy densiometers, or solar pathfinder instruments.

Initial Monitoring Needs

The detailed Water Quality Implementation Plan, to be developed by Ecology with review and participation of local agencies and organizations, will prioritize locations for addressing water

quality problems, assign local responsibility, list cleanup activities needed to address the problem, and develop a schedule for activities.

Ecology will facilitate an annual review of water quality data and cleanup activities with participation by local organizations and agencies, including Snohomish County Surface Water Management, the Stillaguamish and Tulalip Tribes, the City of Arlington, Snohomish Conservation District and other partner watershed organizations. The changes in land use and the measures used to reduce the impact of land uses on water quality should be inventoried, evaluated, and tracked. This will require assistance from partner organizations such as Snohomish County because the County GIS database includes such information.

Ecology will track implementation through the annual review or through individual consultation with the responsible organization. A summary spreadsheet will be developed to assist in tracking. Provided resources are available, the summary spreadsheet will be linked to a GIS map tool to locate cleanup activities as appropriate. Activities such as education and outreach programs that would apply County-wide or watershed-wide will be tracked only on the spreadsheet.

Organizations with Water Quality Monitoring Programs

Organizations with capability and experience in monitoring water quality in the Stillaguamish watershed include:

- Snohomish County Surface Water Management
- Stillaguamish Tribe Natural Resources Department
- City of Arlington
- Tulalip Tribes
- Stilly-Snohomish Fisheries Enhancement Task Force
- Snohomish Conservation District

Ongoing water quality monitoring in the basin is conducted by Snohomish County Surface Water Management and the Stillaguamish Tribe. Ecology long-term river monitoring stations are located at the following sites:

- Stillaguamish River near Silvana (05A070)
- South Fork Stillaguamish River at Arlington (05A090)
- South Fork Stillaguamish River near Granite Falls (05A110)
- North Fork Stillaguamish River at Cicero (05B070)
- North Fork Stillaguamish River near Darrington (05B110)

Next Steps

Once the TMDL has been approved by EPA, a more detailed *Water Quality Implementation Plan* for Stillaguamish Temperature will be developed over the next two years. Ecology works with local organizations, Tribes, and agencies to create this plan, choosing the combination of possible solutions thought to be most effective in the watershed. Elements of this plan will include: the parties responsible for programs, projects and activities, the plan for evaluating effectiveness, targets that will be used to assess progress, and potential funding sources.

This Temperature TMDL shares a goal with the Stillaguamish Chinook Salmon Recovery Plan: to reduce critical season stream temperatures to provide better habitat for cold water aquatic species. Besides Ecology's commitment to this plan, the commitment of Stillaguamish Implementation Review Committee member organizations to salmon recovery and to address the limiting factor of warm stream temperature to salmon recovery will help ensure success.

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Glossary and Acronyms

303(d) list: Section 303(d) of the federal Clean Water Act requires Washington State periodically to prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards and are not expected to improve within the next two years.

Best Management Practices (BMPs): Physical, structural, and/or operational practices that, when used singularly or in combination, prevent or reduce pollutant discharges.

cfs: cubic feet per second

chronic dilution factor:

Clean Water Act (CWA): Federal Act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the CWA establishes the TMDL program.

Designated Uses: Those uses specified in Chapter 173-201A WAC (Water Quality Standards for Surface Waters of the State of Washington) for each waterbody or segment, regardless of whether or not the uses are currently attained.

Effective Shade: The fraction of incoming solar shortwave radiation that is blocked from reaching the surface of a stream or other defined area.

Existing Uses: Those uses actually attained in fresh and marine waters on or after November 28, 1975, whether or not they are designated uses. Introduced species that are not native to Washington, and put-and-take fisheries comprised of nonself-replicating introduced native species, do not need to receive full support as an existing use.

Hyporheic Zone: The volume of saturated sediment beneath and beside streams and rivers where ground water and surface water mix.

Load Allocation (LA): The portion of a receiving waters' loading capacity designated by the TMDL for one or more of its existing or future sources of nonpoint pollution or to natural background sources.

Loading Capacity: The greatest amount of a pollutant loading that a waterbody can receive and still meet water quality standards.

Margin of Safety (MOS): Required component of TMDLs that accounts for uncertainty about the relationship between pollutant loads and quality of the receiving waterbody.

mgd: million gallons per day

National Pollutant Discharge Elimination System (NPDES): National program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, the municipal separate storm sewer systems of medium and large cities and counties, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

Nonpoint Source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the National Pollutant Discharge Elimination System Program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Phase I Stormwater Permit: The first phase of stormwater regulation required under the federal Clean Water Act. The permit is issued to medium and large municipal separate storm sewer systems (MS4s) and construction sites of five or more acres.

Phase II Stormwater Permit: The second phase of stormwater regulation required under the federal Clean Water Act. The permit is issued to smaller municipal separate storm sewer systems (MS4s) and construction sites over one acre.

Point Source: Sources of pollution that discharge at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites that clear more than 5 acres of land.

Pollution: Such contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental, or injurious to the public health, safety, or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish, or other aquatic life.

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, saltwaters, wetlands and all other surface waters and water courses within the jurisdiction of the state of Washington.

Total Maximum Daily Load (TMDL): An estimated quantity of a substance in a waterbody that permit it to meet water quality standards. A TMDL is equal to the sum of : 1) individual wasteload allocations (WLAs) for point sources, 2) the load allocations (LAs) for nonpoint

sources, 3) the contribution of natural sources, and 4) a Margin of Safety to allow for uncertainty in the wasteload determination. A reserve for future growth may also be provided.

Wasteload Allocation (WLA): The portion of a receiving water's loading capacity allocated to existing or future point sources of pollution. WLAs constitutes one type of water quality-based effluent limitation.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a lower elevation central collector such as a stream, river, or lake.

Appendices

Appendix A. Record of Public Participation

Introduction

Development of the Stillaguamish TMDL for temperature has its origin in the Stillaguamish Watershed Action Plan (January 1990). This "Non-Point Action Plan" was developed under WAC 400-12 under a Centennial Fund grant to Snohomish County. To provide for strong public involvement in development of the watershed plan, a Citizens Advisory Committee was formed. Now, renamed the Stillaguamish Implementation Review Committee (SIRC), the committee is the lead entity for salmon restoration planning in the watershed and has continued to provide strong support for and coordination of water quality improvements.

Ecology's TMDL process in the Stillaguamish includes the milestones listed below, followed by approximate dates for completing the TMDL in 2007:

June 1994—Ecology Water Quality Needs Assessment for Skagit/Samish/Stillaguamish Watersheds identified a "Lower Stillaguamish & Portage Creek TMDL for DO, turbidity and FC" as a medium priority future project (Ecology 1994)

March 2000—Pre-TMDL Assessment completed

2001—Quality Assurance Project Plans completed for Temperature TMDL study (July) and for Fecal Coliform, Dissolved Oxygen, pH, Arsenic and Mercury TMDL study (December).

June 2000 – June 2002—Data for TMDLs based on water quality sampling by Ecology with additional data provided by the Stillaguamish Tribe and Snohomish County Surface Water Management. Aerial surveys of Stillaguamish Watershed for infrared sensing of water temperature on Sept. 7 and 8, 2001.

2003 and 2004—Analysis of TMDL data. Computer models used to model effects of changes in riparian vegetation, water withdrawals, channel width changes and riparian microclimate changes on stream temperature under critical low flow conditions.

2003 and 2004—Watershed meetings on progress of the TMDL study

November 4, 2004—Draft Summary Implementation Strategy distributed by email to watershed advisory group, local agencies, Tribes and made available online at Ecology's WRIA 5 TMDL website.

November 9, 2004—Public meeting on Draft TMDL Summary Implementation Strategy (Water Quality Improvement Report).

December 17, 2004—Public comment period closed.

May 2006 – Review of updated draft Water Quality Improvement Report by Stillaguamish watershed organizations

June 2006—TMDL Water Quality Improvement Report to be submitted to EPA for approval

2007—TMDL Water Quality Implementation Plan to be developed by Ecology with watershed organizations

Summary of comments and responses

Comments on Temperature TMDL received during the public review period November 9 – December 17, 2004, are paraphrased below, followed by Ecology's responses. Many comments were addressed by adopting recommended text changes in this Submittal Report; those that were not, are included here. Responses to comments on the Instream Flow Rule Presentation for the Stillaguamish River watershed were provided by Water Resources Program, Ecology Northwest Regional Office.

Comment. Recommendations in the plan that discuss pollutants other than bacteria, dissolved oxygen, or temperature, or any recommendations that discuss nutrients, are inappropriate.

Response: Temperature, fecal coliform, and dissolved oxygen were the major pollutants evaluated in the Stillaguamish River Watershed TMDL studies. However, nutrients, pH, arsenic, mercury, suspended sediment, channel structure, riparian conditions, and instream flows were all discussed in the temperature and conventional contaminants TMDL technical documents. Nutrients, including load allocations, were specifically discussed in their relation to dissolved oxygen and pH conditions in the Stillaguamish River mainstem and its two major forks in the conventional contaminants report. Suspended sediment reductions were recommended to reduce mercury and arsenic concentrations in the convention contaminants report, and to reduce temperatures from channel filling and bank erosion (channel widening) effects in the temperature report**.**

Comment: References to retirement or purchases of water rights are inappropriate in a TMDL for bacteria, oxygen and temperature. In addition, the previous page notes that groundwater may deplete dissolved oxygen in surface waters.

Response: Increasing seasonal instream flows by retirement or purchase of water rights are reasonable measures to improve stream temperature. Larger volumes of water take longer to heat. In addition, groundwater inflows can provide relatively cool water during the warmer seasons. Depletion of surface water oxygen concentrations from groundwater inputs does not occur in all situations. Not all groundwater has depressed oxygen concentrations, and some stream channel geometries allow quick reaeration of groundwater.

Comment: References to sediment as a pollutant in the TMDL are not appropriate.

Response: Sediment control measures were mentioned in the context of improving instream temperatures. The temperature TMDL technical report demonstrated that channel geometry is an important factor for instream temperatures in the Stillaguamish River watershed. Bank erosion widens channels, reduces the effectiveness of riparian shading, and adds excessive sediment to the stream channel. Excessive sedimentation of channels reduces hyporheic exchange (i.e., introduction of subsurface groundwater) by impeding vertical hydraulic gradients.

The Fecal Coliform and Dissolved Oxygen TMDL (Ecology April 2005) addresses arsenic and mercury in the watershed as well as fecal coliform bacteria, pH and dissolved oxygen. The analysis demonstrated that arsenic and mercury tend to be associated with sediment particles; measures that reduce the overall sediment load in the river are recommended for their effect in reducing arsenic and mercury as well.

Comment: Under section titled "Identified Needs and Early Action Proposals," remove reference to County involvement with the in-stream flow rule. It is not clear that Snohomish County has any obligations under the Instream Flow rule that would tie County actions to reductions in stream temperature. Similarly, it is inappropriate to include County Planning Department in Table 10, "Agency Policy or Program Changes that Could Help Achieve TMDL Goals."

Response: Reference to the Instream Flow rule, which has its own regulatory process, has been modified in this Temperature TMDL Water Quality Improvement Report (Submittal Report). We have changed this to a general recommendation for approaches such as flow augmentation and voluntary retirement or purchase of water rights that could increase available flow during low flow season.

Comment: Under section titled" Identified Needs and Early Action Proposals", under highest priorities for reducing stream temperatures, the third bullet states that the connection between excessive sediment load and warming stream temperatures is not direct. References to sediment should be deleted from this cleanup plan. Degradations that are vital to fish habitat can be included in other planning efforts. This bullet should be deleted.

Response: Refer to the response above regarding sediment. Sediment control is necessary to improve instream temperature regime by controlling channel widening and bed sedimentation.

Comment: The TMDL addresses only problems associated with low flows and salmon, and ignores problems associated with high flows.

Response: The TMDL study includes an analysis of the seasonal variation and critical conditions associated with periods of more frequent or higher exceedances of water quality standards.

Comment: Doesn't mature riparian canopy have a significant impact on cooling smaller channels such as Streams Type 3, 4 and 5 as opposed to 1 and 2? Would this effect of mature canopy make the Instream Flow Rule less important?

Response: It is true that the same width buffer consisting of mature riparian canopy would be relatively more effective in cooling smaller streams compared with larger streams. The riparian vegetation recommendations of the Temperature TMDL are designed to reduce water temperatures; their ability to protect flow or increase flow was not addressed in this analysis.

Comment: Has the instream flow rule already been established?

Response: The Stillaguamish Instream Flow Rule became effective on September 26, 2005.

Comment: The Instream Flow Rule has significant implications for Arlington's current and future water rights and perhaps for its wastewater operations. Please clarify that domestic uses identified in the draft TMDL Strategy apply only to unincorporated areas and not municipalities. (Similar comments from both City of Arlington and Snohomish County Planning.)

Response: The Department of Ecology appreciates the concerns expressed by the City of Arlington and Snohomish County. We recognize and support the City's intent to make full use of existing water rights. We also note the Instream Flow Rule does not impact existing rights. The Rule will preclude future water diversion from lowering the instream flow below the established minimums, which in turn will support the TMDL objectives. Ecology agrees with the City that the Instream Flow Rule will affect how cities, special purpose districts, and private citizens obtain water rights for public water supply in the future. The Instream Flow is a water right, and like any new water right, will have implications for future use from that source.

The domestic uses identified in the draft TMDL strategy apply only to unincorporated areas. The domestic use referenced is the residential and small business reservation to meet basic human needs in the Instream Flow Rule. Use of water under the reservation will be in the rural areas and not in areas served by existing public water systems.

List of public meetings

April 22, 2003 – SIRC workgroup meeting, Silvana. TMDL progress report.

September 9, 2004 – SIRC workgroup meeting, Silvana. TMDL progress report.

November 9, 2004 – Pioneer Museum. Arlington, WA. Ecology public meeting on the Stillaguamish Instream Flow Rule and on implementation strategies for the Stillaguamish Fecal Coliform, Dissolved Oxygen, pH, Arsenic and Mercury TMDL, and the Stillaguamish Temperature TMDL

From: Altose, Larry
Sent: Thursday, December 09, 2004 6:15 PM
To: Lawrence, Sally (ECY); Hirschey, Steve
Cc: Garland, Dave; Palenshus, DouGlas; Beitel, Judy; Swenson, Dan
Subject: News; Stanwood-Camano News; 11-2-04; Stilly

Stillaguamish watershed plans back for review

Department of Ecology (Ecology) will sponsor an open house and two public meetings Tues, Nov. 9 in Arlington so people can learn about the department's efforts to improve water quality and allocate future water supplies in the Stillaguamish watershed.

Two separate presentation and discussion sessions, each covering both topics, will be offered at Arlington's Stillaguamish Valley Pioneer Museum, 20722 67th Ave. N.E. The first public meeting will be held from 3 to 5 p.m., followed by an open house from 5 to 7 p.m., with the second meeting from 7 to 9 p.m.

Ecology, in conjunction with local organizations, has been identifying pollutants and developing a water cleanup plan for the Stillaguamish watershed.

According to public information officer Larry Altose, the river basin is failing to meet state water-quality standards due to the following:

- Elevated concentrations of fecal coliform pollution from farms, domestic and wild animals, failing septic systems, urban storm water runoff and leaking sewer systems.
- Decreased levels of dissolved oxygen. Fecal coliform and other nutrients such as fertilizers enter the watershed and feed algae blooms that use up available oxygen. Low dissolved oxygen levels threaten salmon and other aquatic life.
- High summer water temperatures. A lack of sufficient streamside shading, upstream landslides, bank erosion and low stream flows all contribute to warm water problems which harm fish and other wildlife.

A proposed water cleanup plan for the Stillaguamish is available at the Stanwood Library or visit www.ecy.wa.gov/programs/wq/tmdl/watershed/tmdl_info-nwro.html.

Ecology will also present features of a new draft rule the department is considering to help determine how water in the Stillaguamish basin ought to be allocated for future uses. When formally adopted, the rule is intended to:

- protect fish, wildlife, water quality, recreation and aesthetics in the watershed while also providing water for future domestic uses;
- set minimum stream flows for rivers and creeks in the Stillaguamish watershed;
- protect water levels for lakes and ponds in the watershed;
- reserve a certain amount of ground water for future domestic use that won't need a new water right; and,
- set aside sufficient water for grazing livestock without needing a new water right.

The public is invited to ask questions and provide comments about the concepts and issues Ecology is seeking to address through the stream-flow rule. According to Altose, Ecology will present a formal proposed stream-flow rule for the Stillaguamish watershed later in the winter and will conduct public hearings next year before a rule is adopted.

Comments about the Stillaguamish water cleanup plan should be addressed by Fri., Dec. 10, to Sally Lawrence, Department of Ecology, 3190 160th Ave. SE, Bellevue, WA 98008; e-mail: slaw461@ecy.wa.gov, or phone 425-649-7036.

Comments regarding the features and issues for consideration in the draft Stillaguamish stream-flow rule should be sent by Fri., Dec. 10, to Steve Hirschey at the above address or shir461@ecy.wa.gov or phone 425-649-7066.

Appendix B. Riparian Restoration Projects Already Completed

Table B-1. Recent City of Arlington Projects Addressing Impaired Waters in Stillaguamish Watershed

Project Title	River Segment	Parameter Addressed	Organization	Date Started/ Completed	Comments
Public Education					
Signs at arterial-stream crossings	Portage Cr	General	City of Arlington	2002	Objective: watersheds, water quality, fish
Provide contact information for enforcement at task force projects		Temperature	SSFETF, City of Arlington	2003	
"Arlington Update" newsletter articles on water quality programs and actions	All basins in city limits	General	City of Arlington	Quarterly	
"Arlington Times" newspaper articles on watershed subjects	All basins in city limits	General	City of Arlington		Regularly published, great support
Storm drain stenciling	All basins in city limits	Dissolved Oxygen	City of Arlington		"Dump No Waste, Drains To Stream"
Watershed Protection program at airport and industrial center	Portage Cr (also Quilceda)	Temperature, Dissolved Oxygen	City of Arlington	2003	Engage businesses in BMPs and good housekeeping practices
Research and inspection of all septic systems at the airport	Portage creek springs	Groundwater	City of Arlington	1998-2000	Good opportunity to outreach and inventory airport businesses
Participated in the Portage Creek Stewardship program	Portage Cr	Temperature, Dissolved Oxygen	City of Arlington	January – May 2003	Included planting, native plant salvage, speakers, bus tours
Public Participation					
Began operation of new state of the art Wastewater Treatment plant	All City, other than areas served by Marysville	Dissolved Oxygen, Fecal Coliform, BOD, COD	City of Arlington	1997	Management is researching methods to decrease impacts to fecal coliform and nutrients
Golf course ponds water quality improvements	Prairie Cr	Temperature, Dissolved Oxygen, Nutrients	Gleneagle golf course, High School Vo-Tech, City of Arlington		Management changes to solve waters quality problems; High School vocational program for plantings
March Creek water quality investigation	March Cr	Fecal Coliform, Dissolved	City of Arlington, landowners		Coordinated with landowners for monitoring access, gage installation, management history,

Project Title	River Segment	Parameter Addressed	Organization	Date Started/ Completed	Comments
Public Education					
		Oxygen, Temperature, Nutrients			pollution sources, improvement alternatives
Citizen Advisory Committee on Stormwater	All basins in city limits	General	City of Arlington	Ongoing	Education and social needs
Planning and Development					
NPDES Phase II application	All basins in city limits	General	City of Arlington	2003	On-time submittal
SCD Annexation		General	City of Arlington	2003	Annexed in to the Snohomish Conservation District
Adopted new Critical Areas regulations	All basins in city limits	Temperature, Dissolved Oxygen	City of Arlington	2003	Buffers up to 150' on ESA habitats
Significant tree rules	All basins in city limits	Temperature	City of Arlington		Encourage forest retention
Low Impact Development	All basins in city limits	Water Quantity	City of Arlington		Encourage LID designs where a viable option
Developed strict TESC standards	All basins in city limits	Sediment	City of Arlington		Require meeting project specific NPDES limits (see also Enforcement)
Identified Priority Protection Areas	All basins in city limits	Temperature, Dissolved Oxygen	City of Arlington		Developed capital plan using Ecology's wetland characterization method to identify 100's of acres of wetlands and 3,000 feet of streambanks (see attached table E-2)
Enforcement					
Enforce TESC standards	All basins in city limits	Sediment	City of Arlington	Ongoing	Code enforcement on construction sites
Construction project turbidity monitoring	All basins in city limits	Sediment	City of Arlington		Mandate projects with sediment problems sample outfall for Turbidity

Project Title	River Segment	Parameter Addressed	Organization	Date Started/ Completed	Comments
Public Education					
Operations and Maintenance					
Gleneagle pet waste station	Prairie Cr	Fecal Coliform	City of Arlington		First one installed; frequently used
Prairie Creek Storm Detention System Cleaning	Prairie Cr	General, Water Quantity	City of Arlington	2004	Restore capacity to reduce peak flows, address urban flooding and habitat issues
Riparian Restoration					
Numerous stream and wetland restoration projects (see attached Table A-2)	All basins in city limits	Temperature, Dissolved Oxygen	City of Arlington		Total 5.5 miles and >53acres; most recently Hecla wetland restoration _
Provided trees to landowners willing to plant along critical areas	City wide	Temperature, Dissolved Oxygen	City of Arlington	Ongoing	Estimated 500 trees 2003/4
Supplemental plantings and maintenance in existing riparian restoration projects	Citywide	Temperature, Dissolved Oxygen	Banksavers, City of Arlington	Ongoing	Estimated 400 trees 2003/4
Prisoner crew plantings—new plus follow-up maintenance	Citywide	Temperature, Dissolved Oxygen	Oscar Cullem, City of Arlington	Ongoing	5 acres 2003/4
Portage Creek ponds vegetation enhancement	Portage Creek	Temperature, Dissolved Oxygen	Pioneer Museum, City of Arlington	2003/4	Added vegetation around the ponds where feasible due to historical dikes
Golf course plantings near ponds		Temperature, Dissolved Oxygen	Gleneagle golf course, High School Vo-Tech, City of Arlington	2003/4	Also see Public Participation
Wetland Creation / Acquisition					
Eagle Creek elementary school wetland creation	Eagle Cr	Temperature, Nutrients	City of Arlington		3 acres
Pioneer elementary school wetland creation	Prairie Cr	Temperature, Nutrients	City of Arlington		6 acres
Monitoring					

Project Title	River Segment	Parameter Addressed	Organization	Date Started/ Completed	Comments
Public Education					
Illicit discharge detection and elimination		Fecal Coliform, Dissolved Oxygen	City of Arlington		e.g., as discovered during sewer inspections
Increase water quality staffing		General	City of Arlington		New hire in Utilities Department May 2004
Continuous water quality monitoring stations	Portage Cr, Prairie Cr	Temperature, Dissolved Oxygen	City of Arlington		Hydrolab Quanta monitors installed at 2 sites, some work yet to be done on Prairie
Stormwater outfall monitoring	Largest stormwater outfall; discharge to mainstem Stilly	Fecal Coliform, Dissolved Oxygen, Temperature	City of Arlington	September 2003	Main old town outfall plus background conditions in River; monthly
Source water monitoring	Mainstem Stilly	Temperature, Turbidity, pH, Conductivity, Water Quantity	City of Arlington		Daily (mostly) by Water Department
Wastewater NPDES compliance effluent monitoring	Mainstem Stilly	Fecal Coliform, Dissolved Oxygen, Temperature	City of Arlington		
Wastewater additional effluent monitoring	Mainstem Stilly	Total Phosphorus, Total Kjeldahl Nitrogen	City of Arlington		
March Creek water quality investigation	March Cr	Fecal Coliform, Dissolved Oxygen, Temperature	City of Arlington		Mapping, water quality sampling, survey cross-sections and culverts to evaluate potential alternatives for correcting deficiencies plus provide

Project Title	River Segment	Parameter Addressed	Organization	Date Started/ Completed	Comments
Public Education					
					stormwater treatment; see also Public Participation
Construction project turbidity monitoring	All basins in city limits	Sediment	City of Arlington		Mandate projects with sediment problems sample outfall for Turbidity

Table B-2. Priority areas inside and outside of Arlington's Urban Growth Boundaries identified as critical components to restore or maintain naturally sustaining watershed process including flood storage, water quality, fish and wildlife habitat, groundwater recharge, discharge and others.

Project Name	Sub-basin	Area or lineal	Stream/ Wetland	Solve identified problems
Portage Mill Reach	Portage Creek	3,000 feet left bank	Stream	Rearing Stabilization
Wetland 1051	Portage Creek	127.1	Wetland/ Stream	Temperature, Nutrients Flood Storage, Base Flow, Bird Diversity
Wetland 1561	Portage Creek	56 acres	Wetland/ Stream	Nutrients, Flood Storage Bird Diversity
Wetland 1247	Portage Creek	18.9 acres	Wetland/ Stream	Temperature, Sediments Nutrients, Flood Storage Base Flow, Bird Diversity
Wetland 1144	Prairie Creek	8.27 acres	Wetland/ Stream	Temperature, Sediments Nutrients, Flood Storage Base Flow, Bird Diversity
Wetland 0979	Prairie Creek	9 acres	Wetland/ Stream	Temperature, Flood Storage, Base Flow, Bird Diversity
Wallace Ponds	Kruger Creek	40 acres	Wetland/ Stream	Temperature. Nutrients Flood Storage, Base Flow, Bird Diversity
Jensen's Farm ESA	Kruger Creek	6.5 acres	Stream	Temperature, Sediments Nutrients, Flood Storage Base Flow, Bird Diversity Fish abundance
Wetland 0888	Eagle Creek	127 acres	Wetland	Temperature, Nutrients Flood Storage, Base Flow, Bird Diversity
Clay Cliff Ponds	Eagle Creek	23 acres	Wetland/ Stream	Temperature, Nutrients Flood Storage, Base Flow, Bird Diversity
Graafstra Farm	Eagle Creek	41 acres	Wetland/ Stream	Temperature, Nutrients, Flood Storage, Base Flow, Bird Diversity, Fish Diversity
Valley Gem	March Creek	96 acres	Wetland/ Stream	Temperature, Nutrients Flood Storage, Base Flow, Bird Diversity

Table B-3. Riparian Restoration, Maintenance or Protection Activities – Estimates of projects within the City of Arlington, by sub-basin beginning upstream.

Project Name	Sub-basin	Estimated Lineal length	Avg. Total Width or landowners stream bank	Average Forest Age Class H = Healthy M = Medium S = Sparse
New High School	Portage Creek	2,000	150' Left Bank and lower Right	60 years H
Hecla Wetland	Portage Creek	900'	120'	3 years H
Jensen's farm	Portage Creek	1,400'	115'	5 years H
Mill Reach	Portage Creek	3,000	50' Right bank	13 years S
Zimmerman	Portage Creek	330'	50'	Planting 2002/3
Ronning	Portage Creek	330'	75'	Planting 2002/3
Rivercrest	Portage Creek	1,800	75' Right Bank	50 years H
Alterna-care	Kruger Creek	300'	33'	8 years M
Wallace Ponds	Kruger Creek	500'	80'	Planting 2003
Portage Estates	Kruger Creek	800'	60'	10 years M
Jensen's Farm	Kruger Creek	1,400	115'	6 years H
Casperson	Prairie Creek	700'	100'	Planting 2003
Magnolia2003	Prairie Creek	1,000	100'	50 % Planting 50% 50 yrs M
Gleneagle	Prairie Creek	4,000	50'	50 Year H
AVL	Prairie Creek	3,000	100'	20 Year M
McKinley	Prairie Creek	500'	75'	3 year H
Jensen's B. Park	Prairie Creek	1,300	100'	4 year H
Newell Machine	Prairie Creek	700'	60'	5 year S
67th and 204th	Prairie Creek	300'	20'	8 years S
Zimmerman	Prairie Creek	500'	100'	Planting 2002/3
Ronning	Prairie Creek	120'	50' Right Bank	Planting 2002/3
Post Middle	Eagle Creek	700'	160'	50% 80 years H 50% 3 years M
Total		28,080		
		5.3 miles		

Table B-4. 2002-2004 Stillaguamish Tribe BankSavers Riparian Planting in Stillaguamish Watershed

Site Identifier	Linear ft	Miles	Avg. Buffer Width	Acreage	# of Plants	Water Body	Project Partner
A	1650		30	1.1	1234	Unnamed trib to NF Stilly	Snohomish Conservation District
B	1200		20	0.6	503	Glade Bekken (Trib to Lower Stilly)	Snohomish Conservation District
C	15650		50	18.0	2161	Old Stilly Channel	Max Albert's Old Stilly Channel Project
D	600		15	0.2	500	Stilly Mainstem	None
E	1500		50	1.7	2059	Stilly Mainstem	None
F	1854			6.0	2500	Pilchuck Creek	CREP project
G	1300		50	1.5	2005	Church Creek	Snohomish County-SWM-Jake Jacobson
H	3320		25	1.9	326	Church Creek trib	Snohomish County-SWM-Jake Jacobson
I	300		30	0.2	505	Church Creek trib	Snohomish County-SWM-Jake Jacobson
J	1300		45	1.3	130	Old Stilly Channel	Max Albert's Old Stilly Channel Project
K	400		60	0.6	110	Old Stilly Channel	Max Albert's Old Stilly Channel Project
L	945		40	0.9	562	Stilly Mainstem	None
M	2660		20	1.2	1426	Unnamed trib to NF Stilly	Stilly-Snohomish Task Force
N	2000		80	3.7	1332	Old Stilly Channel	CREP project
O	1039			4.3	1487	Stilly Mainstem	CREP project
P	1800		300	12.4	1300	NF Stilly @ C-Post Bridge	Stilly Tribe DNR
Q	600		20	0.3	500	Trib to NF Stilly	Snohomish Conservation District
R	3500		30	2.4	1700	Harvey Creek/Kackman Creek	Snohomish Conservation District
Totals for all projects	**41618**	**7.9**		**58.3**	**20340**		

Table B-5. Portage Creek Watershed Revegetation Sites - Stillaguamish Tribe BankSavers Project

Site #	# of Plants Planted	# of Plants to be Planted	Maintenance Services	Acres Protected	Length of Project	Avg. Buffer Width/Fencing Installed	Project Partner
1	2450.0		Yes	2.2	3200 ft	30 ft/4400 ft	
2	2260.0		Yes	1.9	4150 ft	20 ft	
3		3500	Yes	2.3	2000 ft	50 ft	Snohomish County / NOAA grant
4	594.0		Yes	0.6	1300 ft	20 ft	
5	4962.0		Yes	3.3	7110 ft	20 ft	
6	1099.0		Yes	1.1	1200 ft	40 ft	Stilly Tribe DNR
7	3576.0		Yes	3			Snohomish County Parks / Task Force
8	1365.0		Yes	1.5	1200 ft	60 ft	Stilly-Snohomish Task Force
9	4611.0		Yes	3	2600 ft	50 ft	Stilly Tribe DNR
10	889.0		Yes	1.4	3000 ft	20 ft	
11			Yes	2.1	3000 ft	30 ft	Stilly Snohomish Task Force
12	200.0		Yes	1.1	2000 ft	25 ft	Stilly Snohomish Task Force
13	200.0		Yes	0.6	500 ft	50 ft	Stilly Snohomish Task Force
14	270.0	2300	Yes	3.5	5100 ft	30 ft	Stilly Snohomish Task Force
Totals	22476.0	5800		27.5	36360 (6.9 miles)	20 to 60/4400 ft	

Table B-6. Recent Snohomish County/Partner Projects Addressing Impaired Waters in Stillaguamish Watershed

Project Title	*River Segment*	*Parameter Addressed*	*Organization*	*Date Started/ Completed*
	Pilchuck Creek Trib80a		*Stillaguamish Tribe*	
Streambank Revegetation (many individual projects)	*Indian, Church, Deer, Deforest, French, Jim, Jorgenson Slough, Portage, Porter, Prairie, Riley, Rock, Sills, Trafton II 05-0145*	*Temperature*	*City of Arlington/Stillaguamish Tribe, Snohomish Conservation District, Stilly-Snohomish Fisheries Enhancement Task Force, Stillaguamish Flood Control District, WDFW, DNR, private landowners, Snohomish County*	*1994 - 2004*
Flow Enhancement Structure	*Old Stillaguamish Channel*	*Temperature, Dissolved Oxygen*	*Stillaguamish Flood Control District, Stillaguamish Tribe*	*2003*
Riparian Repair/ Revegetation	*South Fork, Church, Portage, Kackman, North Fork, Trib to North Fork near Trafton, Trib to South Fork off Burn Rd*	*Temperature, some Fecal Coliform locations*	*Snohomish County*	*2001-2004*
Glade Bekken restoration	*Glade Bekken watershed*	*Temperature, Dissolved oxygen, Fecal coliform*	*Snohomish County*	*1996-2001*
Ambient monitoring	*8 sites on mainstem and tributaries*	*Temperature, Dissolved oxygen, Fecal coliform*	*Snohomish County*	*1994-ongoing*
Water quality complaint investigations	*Clean Water District*	*Temperature, Dissolved oxygen, Fecal coliform*	*Snohomish County*	*1994-ongoing*
Church Creek restoration	*Church Creek watershed*	*Temperature, Dissolved oxygen, Fecal coliform*	*Snohomish County*	*2000-ongoing*
Dry Weather Outfall Monitoring	*Clean Water District*	*Temperature, DO, Fecal Coliform*	*Snohomish County*	*1998-Ongoing*
Adult Education (e.g. Watershed Keepers, tours, community events)	*Clean Water District*	*Temperature, DO, Fecal Coliform*	*Snohomish County*	*1994 – ongoing*
Streamside Landowner Workshops	*Clean Water District*	*Temperature, DO, Fecal Coliform*	*Snohomish County with Ecology funding*	*2003 - 2004*
Streamside BMP Direct Mail campaign	*Stillaguamish Basin*	*Temperature, DO, Fecal Coliform*	*Snohomish County with Ecology funding*	*2004*
Teacher and Youth Education	*Most schools in CWD*	*Temperature, DO, Fecal Coliform*	*Snohomish County*	*1996 - ongoing*

Table B-7. Snohomish Conservation District: 2004 Public Education Projects in Stillaguamish Watershed

Project Title	River Segment	Parameter Addressed	Organization	Date Started/ Completed	Comments
Spring Farm Clinic	Lower watershed	General	Snohomish CD	4/24/04	Held at Stanwood Grange
Ice Cream Social	Lower watershed	General	Snohomish CD	6/18/04	Held at private farm, Arlington
Silvana Fair (booth)	Lower watershed	General	Snohomish CD	7/31/04	At Silvana
Stanwood-Camano Fair (booth)	Lower watershed	General	Snohomish CD	8/6-8/8/04	In Stanwood
Festival of the River (booth)	Lower watershed	General	Snohomish CD	8/6/04	In Arlington
Fall Farm Workshop	Lower watershed	General	Snohomish CD	10/9/04	At Stanwood Grange

Table B-8. Snohomish Conservation District: 2004 Projects in Stillaguamish Watershed

Project Type	River Segment	Project Type	River Segment
Site visit/farm plan review	Arlington Junction South	Planting/site visit/Nutrient management	Hat Slough South
Site visit/farm plan review	Arnot Road Drainages	Data collection & Evaluation/Meetings/Site visit/farm plan review	Hell-Hazel Drainages
Site visit/farm plan review	Boulder Ridge	Data Collection & Evaluation/ Nutrient Management/Site visit/farm plan review	Higgins Ridge Area
Fencing & Structural BMPs/Site visit/farm plan review	Burn Hill Road Drainages	Firebreak/Structural BMPs/Site visit/farm plan assistance	Jackson Gulch
Site visit/farm plan review	Church Creek	Structural BMPs/Site visit/farm plan review	Jim Creek
Site visit/farm plan review	Deer Creek	Nutrient management/Fencing/ Site visit/farm plan review	Jordan Road Drainages
Project Type	**River Segment**	**Project Type**	**River Segment**

Brush Management/Structural BMPs/Site visit/farm plan review	Ebey Hill Drainages	Data Collection & Evaluation/Fencing/ Site visit/farm plan review	Kackman Rd Drainages
Data collection/Site visit/farm plan review	Frailey Mountain Drainages	Structural BMPs/Data Collection & Evaluation/ Site visit/farm plan review/Nutrient management/Brush management	Pilchuck Creek
Site visit/farm plan review/Data collection, Structural BMPs/Tree & shrub establishment	Glade Bekken	Fencing/ Site visit/farm plan review	Silvana Terrace
Fund raising/ Site visit/farm plan review	Grandview Area	Site visit/farm plan review	Squire Creek
Data Collection/Fencing/Site visit/farm plan review	Harvey Armstrong Creek	Structural BMPs/Data Collection & Evaluation/ Site visit/farm plan review/Nutrient management/Brush management/Pest management	Stillaguamish Floodplain

Appendix C. Cost Estimate for Highest Priority Riparian Restoration

This section provides a cost estimate for completing the water quality improvement projects of the type likely to be undertaken to implement this TMDL. The cost of riparian planting and maintenance for the 55 highest-priority half-mile stream reaches (Figure 2) in the watershed can be estimated by using these figures:

- $75,000 = approximate cost of 1 mile of installation riparian planting (assumes 100-ft buffer and $15,000 installation cost per 1,000 ft stream reach, using low-cost labor)[1]
- 55 reaches x ½ mile per reach x $75,000 per mile = $2,062,500
- An additional annual maintenance cost of $2500 per mile of stream reach ($68,750) should be considered. Maintenance is needed in the first five years of a project to ensure plant survival.
- Total: $ 2,131,250.

These figures are provided to give a rough estimate of the financial investment that may be required to meet the goals of the TMDL. Some projects can be accomplished for less money using volunteer labor, however, complex projects could be more expensive.

[1] *Cost estimates based on information from K. Knight, The Stillaguamish Tribe Bank Savers Project, personal communication, 2004.*